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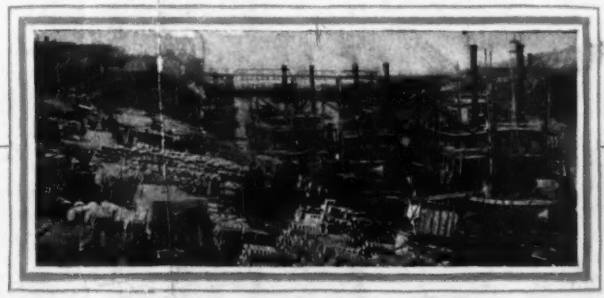
THE NEW YEAR'S NUMBER

This first-of-the-year issue has been planned with the thought of presenting reviews and editorial comment only on those phases of engineering which have shown substantial progress during 1919. The past year has been abnormal for, with the exception of the striking case of the highways, construction has been marking time.

Nevertheless the minds of engineers have been active in other channels. Throughout the country there has swept a realization by engineers of the need for raising the profession to the place it should occupy in our national life. Professional unity, compensation and licensing of engineers are subjects which have stood out at local and national gatherings of technical men during 1919

Through the medium of editorial review and special article an attempt has been made to appraise the year's results:

THE HIGHWAY SITUATION is dealt with at length in two reviews by C. S. HILL and an editorial.
THE PHYSICAL CONDITION OF THE RAILWAYS is discussed frankly and authoritatively.
ENGINEERING SOCIETY AFFAIRS, COMPENSATION, and EDUCATION are dealt with in editorials.



Beginning in This Number a Special Article Entitled:

"What is the Future of Inland Water Transportation?"

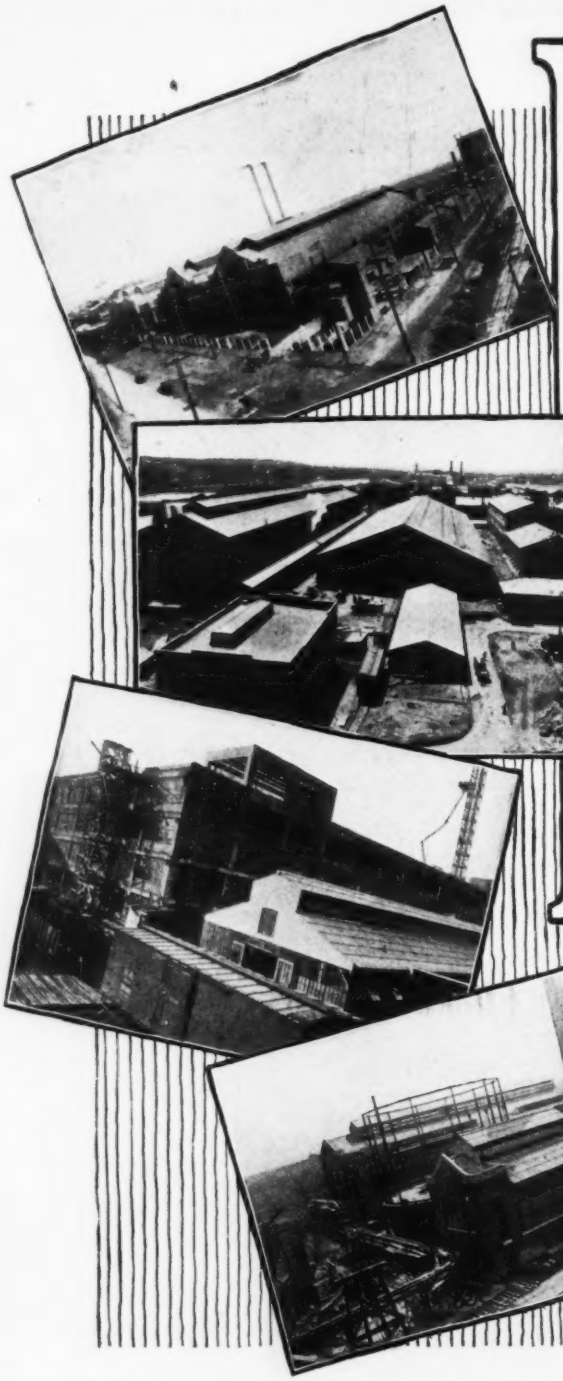
By CHARLES WHITING BAKER

merits a wide reading. It attacks such popularly held fallacies as the one that the transportation of freight by water is always cheaper than by rail, and shows that, with a few exceptions, the inland waterway, in which millions of dollars have been sunk, has failed utterly as an economic transportation factor.

Among the Other Articles Are:

"Using Concrete Proportioned by the Surface Area Method"
By R. B. YOUNG

"Engineering and Adventure"
By r. B. McDONALD



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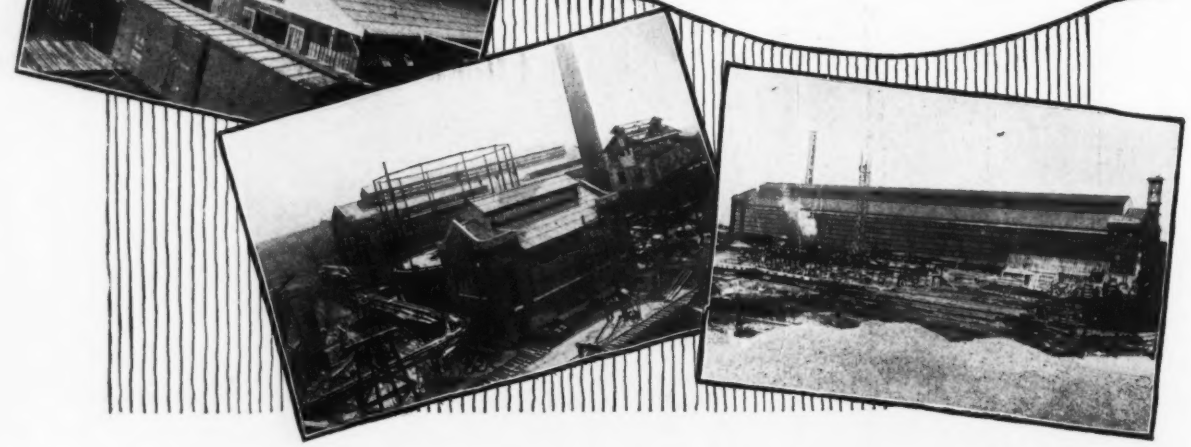

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 84 — NEW YORK, THURSDAY, JANUARY 1, 1920 — Number 1

"Engineering News-Record" is a consolidation of "Engineering News" and "Engineering Record," effected in 1917.

"Engineering News" was founded in 1874 by George H. Frost, as the "Engineer and Surveyor," which title subsequently became the "Engineer, Architect and Surveyor," then "Engineering News and American Railway Journal" and finally, "Engineering News," under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

"Engineering Record" was established in 1877 by Henry C. Meyer as the "Plumber and Sanitary Engineer." The name was subsequently changed to the "Sanitary Engineer," "Engineering and Building Record" and, finally, to "Engineering Record." During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The staff of "Engineering News-Record" consists of

E. J. Mehren, *Editor*
R. K. Tomlin, Jr., *Managing Editor*
M. N. Baker — H. H. French
F. E. Schmitt — J. W. Shaver
F. C. Wight — G. A. N. Thall
Charles Whiting Baker, *Consulting Editor*
Chicago: W. W. DeBerard, E. E. R. Tratman, C. S. Hill
San Francisco: N. A. Bowers

Returning the Railroads

BY HIS proclamation of Dec. 24 ordering the return of the railroads Mar. 1 of this year, the President has swept away the cloud of uncertainty that enveloped the situation because of the failure of Congress to enact adequate legislation before Jan. 1, 1920. Under existing circumstances, the return of the properties now would result in serious complications. The way has been cleared for Congress to complete the difficult task of reconciling the differences in two vitally different measures upon which we comment elsewhere.

The Industrial Situation

AN EXTENDED review of the industrial situation is not warranted at the present time. The facts stand out too clearly to make comment necessary. We are painfully aware that the year has been unprecedented in the number and seriousness of labor difficulties. It is equally clear that the situation is decidedly better now than at any time since the armistice was signed. The coal difficulty, it is true, is still with us, and the probabilities are that we have ahead the necessity of adjusting a railroad-labor situation. But, by and large, there is a greater degree of sanity on the labor question than there was at the beginning of the year or in midsummer. We have proved some things to ourselves. We have demonstrated that the country stands for order, not anarchy. We have learned that the vast majority of the workers believe in improving the present order of society rather than in upsetting it and experimenting with a soviet regime. We have shown that in an issue between order and anarchy the people will make any sacrifices that order may triumph. At Boston the National Guard willingly assumed policing duty and thousands volunteered to serve in any capacity needed to maintain the law. In Kansas all classes flocked to the coal mines at the Governor's call. All of this helps to stabilize conditions. The nation has served notice on the reds that we will have no part with them. The demonstration of the public's position has encouraged the sane men in union labor ranks, and progressively saner handling of their problems can be expected there. In general, conditions are hopeful. We look forward toward improving conditions.

1919 in Engineering

SPEAKING generally, the year 1919 will go down in engineering history as one of inaction. Due to the inertia in recovering from the war's dislocation, to shortage of labor and materials and to high prices, all branches of civil engineering were subnormal except that of highway building. Toward the mid-year plans for municipal facilities and housing began to be developed vigorously, but the development did not start early enough in the year to come into the prominence that was accorded highway work. The latter occupied the center of the construction stage, though it, too, suffered curtailment because of the late letting of contracts and the shortage of both materials and labor. Aside from the vigor shown in the highway field, the foremost engineering problem was the disposition of the railways. True, the chief matters at issue are, in the broad sense, political, but their engineering interest is paramount because their solution will determine the policies governing railway expenditures. In nontechnical matters, interest centered upon the engineering societies' problem. The various development and aims and organization committees of the founder societies rendered their reports during the year, and all of them combined in a joint conference report looking to more effective federation by engineering societies. The American Society of Mechanical Engineers has received and approved the report of its aims and organization committee and of the joint conference committee, and this stands as the sole definite action. As in technical activities the year lacked fruitfulness, so did it also in engineering-society affairs. The year was one of adjustment, of settling down, of clarification of views, rather than of action.

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The Coming Year

IN CONTRAST with the relative inaction of 1919, the year 1920 should be a busy one, the limits of activity being set by available supplies of materials and labor and, possibly, by prices. One cannot say that there is a spirit of optimism abroad—or of pessimism, either. It is, rather, a settled determination to go ahead despite conditions.

There are reasons enough to deter the timid. The industrial situation is not yet stable, though it has measurably improved. It was difficult to get materials during the latter part of 1919, and the shortage of railway cars, responsible for the curtailment, will be even worse in 1920. Prices are high; they may go higher, though we hope the peak has been reached. Our present inflation may end in collapse, while a presidential election year has often been given as the reason for proceeding cautiously.

Despite all these possibly adverse conditions, we look forward to a bigger year than the one just closed. In the work held back since the spring of 1917 there is a large volume that the projectors consider cannot be deferred longer, provided costs do not go higher. This is true, among other lines, of highway construction and of a goodly volume of municipal work.

As to labor, there is ground for expecting that, with greater distance from the war's excitement, we shall get greater efficiency. The use of machinery has increased materially in recent years, and it should be used even more widely in 1920. While, therefore, we shall undoubtedly find that the amount of work accomplished in 1920 will be dependent on the number of men that can be obtained, we may expect the work to be in larger volume than would be predicated on the performance in the latter half of 1919.

Labor shortage, of course, affects materials supply, but the limit there was set last year not by the labor available, but by the lack of railroad cars. Steps are being taken by highway officials to make their work less dependent upon rail transportation this year, and, if successful, their efforts should make a larger percentage of supply from existing commercial gravel and crushed-stone plants available for other construction operations.

High prices undoubtedly held back much work last year, particularly in the early part of the season. If prices hold where they now are, the price-factor will not be a serious deterrent this year; enough work will be offered to tax the materials and labor supplies to the utmost. Certainly, no considerable reduction in prices can be looked for. Demand will outstrip supply, with the inevitable tendency to force up prices. On the other hand, producers of materials realize the danger of curtailment should prices go higher, and will do all in their power to prevent a runaway market. The control of the situation, though, lies actually with owners and contractors. If they lose their heads and bid against each other beyond reason, nothing will be able to prevent sharp advances. In some quarters there is now evidence of a slowing up in the launching of new work—a slackening of the boom that appeared to be on the point of getting under way in the summer.

All things considered, however, the indications point to a busy year.

Progress in Licensing

FOUR states enacted license laws for engineers in 1919—Oregon, Colorado, Iowa and Michigan. This puts laws regulating the practice of engineering on the statute books of nearly one-quarter of the states of the Union, an indication that the movement is gaining headway fast. In none of the states have the laws with the more modern provisions been in force long enough to admit of experience, although an opinion from a prominent engineer-educator in Florida, which in 1917 adopted a law founded on the original suggestions of the American Society of Civil Engineers, is that engineers of the state are unanimous in thinking that the law is vastly better than the absence of one, but that it needs some revision.

Engineers in Ohio and Indiana have made efforts to secure laws, and probably at coming sessions results will be obtained. Other features in the movements are the drafting of a model licensing law by the American Institute of Architects, and another by a committee of Engineering Council. Two national bodies, the American Association of Engineers and the American Institute of Architects, have gone on record as favoring licensing.

Opinion on the justification for licensing is crystalizing definitely along the one tenable line, that of public benefit—protection of life, health and property. While there are direct benefits to the profession, they are generally regarded as subordinate.

Present opinion is that the law should be brief, should give much discretion to high-caliber examining boards, and stress educational qualifications and moral fitness.

A citizenship qualification is receiving more serious consideration than at first, while reciprocity features are made as nonhampering as possible, so that nothing will prevent projects attracting the best talent.

Opinion so far expressed in the states having laws is favorable rather than otherwise. With no counter-wind blowing, it may be expected that the licensing movement will continue to gather force in 1920 and that the year will see new laws put on the statute books.

The Year in Engineering Education

ENGINEERING education, like most other activities, was the subject of much discussion a year ago. The school regime had been interrupted by the Students' Army Training Corps, and that had been preceded by the publication of Dr. Mann's report on engineering education. Within the colleges there was, as a result, questioning of the desirability of change; while on the outside was a strong feeling, confidently expressed, that this was not only an opportune time for introducing innovations in the engineering courses, but that engineering curricula were in need of revamping.

Now the year has passed. What has been the result of the ferment? On the whole, there have been few changes, but such as have been made are indicative of an attitude that promises future developments. These changes, too, show the influence of the Mann report and the S. A. T. C. experience.

In a number of schools, an effort is being made to

introduce engineering subjects in the sophomore year, and thus at an earlier period give the student some notion of that with which his life is to be concerned. At the University of Minnesota, for example, in the sophomore year, there is now being taught a combination course in mathematics and mechanics, having this object in view. In several schools new courses in economics are being introduced, not in the dry-as-dust fashion of the liberal arts college, but as an adjunct of engineering problems. In other institutions, notably at Iowa State College, the "Camp Humphreys idea" is being tried. The attention of the student is directed in an engineering way to structures with which he has long been familiar. He is taught to see them in the new light, with the purpose of stimulating his interest and getting him to realize the character of the problem that he must encounter in practice. At the University of Cincinnati, at Yale, and at a number of other schools, stress is being placed upon labor relations. In several institutions, English for engineering students is being placed on a better basis and is being made the vehicle for broadening the student's grasp of history and economics.

The experiments are scattered and in their infancy. Such as they are, however, they seem to reflect the stimulus of the Mann report. The impress is deep enough to warrant the expectation of further developments. Should the effort to interest the student at an earlier period in engineering problems succeed to the extent of causing him to bring fresh energy to his work, the influence of the new methods will be a broad one.

One of the lessons which might have been drawn from the S. A. T. C. experience and from the methods developed in training mechanicians during the war has apparently made no impression. We refer to the possibility of instituting short courses—say of two years—in engineering, with the purpose of supplying the heavy demand for men to fill the lower professional ranks. The S. A. T. C. and mechanicians' courses certainly did show how intensive work could be given. Apparently, however, the teachers of engineering believe that they have no function or responsibility in trying to supply the demand for inspectors, junior draftsmen, etc. We cannot find that serious thought has been given to the subject by the engineering colleges, but to us such thinking would seem a natural consequence of the war-time intensive training experience. Possibly the failure of the S. A. T. C. may have discouraged thinking along these lines. That failure, however, was due to administrative difficulties rather than to the ideas underlying the non-military side of the work.

In general, then, while the year brought forth no great number of changes in engineering curricula, and possibly while we ought to be glad that the conservatism of the past has prevented us from being carried off our feet with ill-considered innovations, it is nevertheless true that there are certain encouraging signs. Going back to his own engineering course, practically every engineer will admit that his interest would have been heightened if there had been a live approach to the problems he was expected to meet in after life. The experience of the year 1919 indicates that some engineering teachers are considering methods of presenting problems in that spirit, and the indications are sufficient to warrant us in looking forward to solid results.

The Precarious Position of Engineering

THERE has been an unusual amount of activity in the year just passed regarding the compensation of engineers. Data have been gathered and compiled in an effective way, and salary recommendations prepared taking cognizance of the engineer's responsibility and of the shrunken value of the dollar.

The new activity has been due to the urge of the increased cost of living, which has been particularly hard upon the salaried class. Very few, however, even of those active in the recent efforts have appreciated thoroughly the seriousness of the situation. We say, without fear of contradiction, that the effects of the present inadequate salary scales will be far more serious to the public than to the engineer. The engineer can protect himself by leaving the profession, which he is doing in large numbers, but the public must bear with such engineering talent as will remain.

Every engineer knows that there is an alarmingly rapid drift out of engineering into commercial pursuits. The seriousness of this drift will be more evident if we give some consideration to the economic situation in which we find ourselves. In every branch of engineering we are at least three years in arrears in construction. War-time restrictions and shortage of labor and materials have prevented the normal amount of construction since the spring of 1917. There is a shortage of housing everywhere, and a shortage of housing necessarily is accompanied by shortage of all of the tributary urban facilities, such as water-supply, sewerage, paving, electric light and telephone service, urban railway transportation, etc.

In addition to the huge task of catching up on housing and municipal facilities, we have a far more urgent problem in highways. Their demand on the profession will alone be tremendous. According to the United States Bureau of Public Roads in 1920 there will be available for expenditure on construction $633,000,000, more than four times as much as has been available in the largest previous construction year. Right now the highway organizations are inadequately staffed, both in size and ability, for the tremendous program in hand. The difficulty is exactly that which befell our war-making agencies in 1917. Overnight they were obliged to increase their size threefold, fourfold, tenfold. Just that is happening in highway work. Except for the State of New York, the programs have been moderate. and the organizations of relatively small size. Upon such organizations, attuned to doing say $2,000,000 or $3,000,000 worth of work a season, have now been thrust $50,000,000 and $60,000,000 bond issues. All of this money is not available for expenditure in one year, but one state hopes to be able to put as much as $32,000,000 worth of work under contract for the next season. It paid out $10,000,000 last year and will probably pay out $25,000,000 in 1920. These are startlingly large sums, and while they represent one of the heaviest programs, $5,000,000 programs will be common this year.

Yet with these expenditures facing the profession, we find salaries so inadequate that there is an alarming desertion from the ranks. Men intrusted with the expenditure of millions get salaries of $5000 a year and less. In fact, the salaries above $5000 in public service

are infrequent. Unless these salaries are raised, we shall not be able to hold men who can put these programs through with credit. Here and there self-sacrificing men will stay, but, by and large, the salaries must be made somewhat nearly adequate to the responsibility, in order to hold good men. The salaries of subordinates are even less commensurate with their responsibilities, and the difficulty of holding competent men proportionately greater.

If the present conditions persist—low salaries, and consequent desertion from professional ranks—there is certainty of disaster and serious reflection upon the engineering profession. There will be brought about an inefficient expenditure of public funds. Engineers will protect themselves by going into other and more lucrative pursuits. The public will be the sufferer.

We hold, therefore, that it is incumbent upon engineers as individuals, upon local engineering societies, and upon the national bodies, to concern themselves most seriously with the problem of engineers' compensation. In taking up the fight they should make no apology. The interests of the public are seriously at stake.

The Year in Society Affairs

THE beginning of the year 1919 found the engineering profession intensely interested in a study of the purposes of its societies. There was a feeling that the war had created new conditions of which cognizance had to be taken by changes in society ideals and organization.

Contrasted with the attitude, then, the interest in society affairs has waned very much. We take it that the average engineer has become engrossed with reëstablishing himself and with the largeness of the problems propounded by the reconstruction era.

Nevertheless, the year has brought a clarification of views regarding some of the society problems that have been confronting us. The reports of the various aims and development committees of the four founder societies have in only one case, as we read them, got down to anything of a fundamental nature, and that is the report of the development committee of the American Society of Civil Engineers. That document proposes changes in organization which correspond, in the main, to demands that have been growing for years. All of the reports agree in this, that the national technical societies should confine themselves to technical work, and that civic and welfare activities should be intrusted to a separate organization. This recommendation is accompanied by a recognition that the national technical societies cannot divest themselves of responsibility for the general welfare of the profession, and all of them provide, through concurrence in the Joint Conference Committee's report, for participation by the founder societies in a separate body whose sole function shall be public and welfare work.

The chief interest in society affairs now centers upon a method by which engineers shall look after their own welfare and have an influence upon civic questions of an engineering character. We have expressed the view that Engineering Council has failed to fasten itself upon the sympathies of the engineers of this country. We see no reason to change that view; the Joint Conference report is an expression of the same idea.

The Joint Conference Committee report proposes a substitute for the council, differing from the present body in that it will allow representation of local societies. While this should help the federated body to grasp the local needs of engineers, there is no expression of those needs in the report. There is no denying that Engineering Council has done some good things, but most of its activities have been on large problems in which the individual engineer has no personal interest. For example, its most ambitious endeavor—its coöperation in the efforts to establish a Department of Public Works—while a notable and laudable object, has not that personal appeal which will secure a large following. Its licensing and compensation activities, on the other hand, are of the type that awaken personal interest. The purposes set up for the federation in the Joint Conference Committee report partake chiefly of the general rather than of the intimate character.

The point of view needed, in our judgment, is that the federation should become a clearing house through which aid can be extended to the local societies. Take, for example, the matter of legislation. Every year sees a flood of state bills that affect engineers and engineering. A clearing house could collect and compare these measures and send to the local societies information on similar legislation—its success or failure—elsewhere. Such a handling of intersociety relations would make in each locality a host of supporters for the federation.

One development of the year stands out as notable—the increase in membership and in effective activity of the American Association of Engineers. Starting the year with less than 3000 members, it ended it with more than 10,000. Its organization work has been no less vigorous than its membership increase. It has dotted the country with chapters and clubs and has been successful in getting these bodies to work. While Engineering Council joined with the association in presenting to the Railroad Administration proposed new scales of salaries for engineers in railroad service, it has been the association and not Engineering Council that has secured the results. It initiated the movement in its conference of railroad engineers in Chicago in March, and through the organization of local bodies in railroad centers has effectively presented the matter to the regional directors. With equal activity it is now attacking licensing and the compensation of highway engineers and again will try to get results, not through headquarters communications, but by action of its subsidiary bodies. By its energy it has risen in a year's time from a relatively inconspicuous organization to one that must be reckoned with in the engineering-society activities of the country.

As to another feature of last year's activities—the union movement—a brief word is needed. Making rapid progress in the early part of the year, the impetus seems to have died down since summer. The locals are holding their own in some sections, but nowhere does there seem to be enthusiasm. This result was to be expected. As conditions become stabilized and compensations are adjusted, the union movement can be relied upon to pass entirely out of engineering ranks. Its views are entirely at variance with the normal thinking of engineers and will have no

permanent hold on the sympathies of even the younger men. In special cases strength may be expected, but there is no possibility of large permanent development.

Where, then, do we stand today in engineering-society activities?

The fever of the early part of the year has gone, and a pretty sane type of thinking can be relied upon in connection with the proposed reorganizations of existing societies and the formation of a federated body. Radical innovations will not come. That which is fundamental in the various recommendations must, however, prevail. Failure to act promptly will merely prolong discussion and agitation until the needful changes are brought about. We are in hope that the principal recommendations of the report of the development committee of the American Society of Civil Engineers—those relating to district organizations and to the strengthening of the technical work of the society—will prevail, and that there will be effected a federation of engineering societies based on the fundamental idea of working as a clearing house or an agency for the locals. Such a federation will still handle the large national problems, but its strength and support would come because of its hold on the individual engineer through the service it would render him by coöperation with his local society.

Highway Construction in 1919 and Its Lessons for 1920

ROAD construction in 1919 was characterized by the extensive employment of large contracting organizations, and by the intensive use of construction machinery. These factors, which should have made for the construction of a large mileage, were offset by adverse factors, so that the programs lagged behind schedule. These adverse factors were an acute shortage of materials, a late start of work and unsatisfactory labor conditions.

While the available statistics are scant, they indicate the situation clearly. In 1916, the year of greatest highway activity, $136,000,000 was expended for paved-road construction. Precise values have not yet been determined for 1919, but in round figures the construction completed aggregated $138,000,000. There was under contract in 1919 work estimated to cost $165,000,000 which was not completed and which has been carried over into 1920. No estimates, even in round figures, are possible of the value of the equipment employed, nor of the number of construction organizations engaged in 1919 compared with previous years, but general observation testifies that both have been vastly greater.

Why has highway construction lagged? An answer to this question is the most important service which a review of the year 1919 can render, because, for every mile of highway under contract in 1919 it is planned to place two miles under contract in 1920. Two-thirds of a billion dollars are available to pay for paved-road construction during the new year. Should there be continuation of the conditions which have caused construction to lag in 1919, there is no hope of finishing the larger program contemplated for 1920. In fact, we may as well admit that even with the best of conditions, we cannot spend the money available for 1920.

With excellent success in securing contractors in 1919, less than half of the mileage which was under contract has been built. Late letting of contracts, shortage of materials and adverse labor conditions all tended to this result.

Contracts generally were awarded late in the season. A decided improvement was accomplished by letting large-mileage contracts, but these, due to their very size, involved delay the first season because of the longer time required to organize and to assemble plants.

Another cause of delay arising from contract conditions has been experimentation with new methods and equipment. Many general contractors, whose operations have normally been in other fields of construction, engaged in road work for the first time in 1919. Having no experience of their own, and the field lacking standardized practice, these contractors were encouraged to experiment in methods and machinery. No new methods is fully successful at the first attempt, and while development is proceeding construction lags.

Acute shortage of construction materials, and particularly of sand, gravel and broken stone, was the main cause of delay. Several circumstances were responsible for the shortage. Lack of railway cars and the ranking of the shipment of road materials as secondary to other traffic demands unquestionably headed the list. Contributing to the difficulty, however, were the crowding of producers in certain localities, which resulted in shipments that could not pass inspection, and a frequent grouping of operations so as to concentrate demands on a few producers, and on a single railway line.

Naturally, efforts were made to overcome the difficulties, but with small success. The most hopeful line of effort is in the direction of developing local material supplies at the roadside or within trucking or industrial-railway haul. This development is due to the fact that railway-car shortage was the chief element in causing materials shortage.

At the close of the season, a new development appeared in connection with materials supply which contains the elements of contention—an obvious and general swing toward state control of materials. Simultaneously contractors took a stand unqualifiedly in favor of complete control by the contractor of the purchase and shipment of materials. Without weighing these opposite ideas, the circumstances command attention because they involve the relationship of the large construction organization and the road officials in developing future road-construction programs.

Labor conditions as a factor in the lagging road construction program of 1919 reached beyond the supply of workmen to the supply of contractors and of engineers. There was a deficiency of workmen, and they were inefficient and unstable in the high degree characteristic of the times. Perhaps on the whole, because of the extensive substitution of machinery, the men in the construction gang contributed less to the year's lagging program than did unqualified contractors.

Analysis of the causes which have been cited as responsible for delayed progress in the highway-construction progam of 1919 is encouraging, because of the clarity with which it discloses that the causes are either temporary or can be largely eliminated by highway officials, except possibly as to materials. Upon car shortage must fall the responsibility for the shortage in paved roads completed last year, and to it, unless cor-

rective measures are enforced, will have to be charged the failure to realize the construction plans of this year, where local supplies are not available.

New Concrete Proportioning Theories Put Into Practice

ANOTHER and most important chapter in the current studies of new methods of proportioning concrete is added by the paper by R. B. Young on p. 33 of this issue. Engineers who were only confused by the earlier discussions of water-cement ratio, fineness-modulus and surface area, and who were disposed to consider the whole matter highly academic, will begin to feel on more sure ground when they read of actual construction, ultimately to total a half-million yards of concrete, in which the concrete is proportioned not in the time-honored volumetric relation but according to quantities determined by desired strengths and the dimensional qualities of the aggregate. Further than that, there is every promise that the work of the laboratory experts will have a definite and salutary effect on the worrisome subject of wet or dry concrete.

Following the introduction of the chute method of placing concrete, and with the spread of reinforced concrete with its narrow forms and impeding steel, the early standards of a dry mix went by the board, and wetter and wetter mixtures became prevalent. Many warnings were given of the danger of this practice, but it was not until about two years ago that the quantitative effect of too much water was pointed out by Professor Abrams. At that time he laid down the principle that within the limits of practical aggregate and workability the strength of concrete is a function of the water-cement ratio in the mix. The practical application of such a principle hinged on the question of workability, and this he decided was a function of the grading of the aggregate, which he measured by a sieve-analysis constant known as the "fineness modulus." About the same time L. N. Edwards arrived at somewhat similar conclusions, except that he related the workability to the surface area of the aggregate.

Encouraged by these theories and the tests which led up to them, a number of engineers, who had been opposed to the prevalent wet mixes, established on their work requirements for dry concrete, and for lack of a better measure of workability specified a "slump" test which in various forms had been used in the different laboratories. According to this, all concrete had to take a certain minimum slump when released from a confining mold. The proportioning was still volumetric, except for the water, which was gaged by the results of the test. The most notable instance of such a specification was on the Illinois roads, and there it has not proved practicable. The tests prescribed almost invariably resulted in so dry a concrete that its workability was impossible, with the result that water was added according to ideas of foremen accustomed to the old, sloppy mix.

It appears, therefore, that a test which may indicate an optimum workability and a proper cement-water ratio in the laboratory is not adaptable to the varying conditions of the field. Here, then, is where Mr. Young's studies are a step forward, for he has decided that it is not necessary quantitatively to test field workability, since, according to the Abrams principle, which he considers his tests to have confirmed, water-cement ratio controls strength within the ranges of any practicable workability. It is only necessary, therefore, to establish that ratio for standard or normal laboratory consistency, and then to use it in the field, always remembering that it is the ratio of the water to the cement which must remain constant.

In other words, instead of following the customary practice of controlling workability by gaging the water alone, on the work of the Ontario Hydro-electric Power Commission a proper or desired consistency is attained by adding or subtracting *both* water and cement in the proportions established by laboratory and field tests of the aggregate to produce a concrete of the desired strength. The absurd reduction of such a practice would lead on the one hand to no cement paste at all, and on the other to aggregate scattered widely through a great mass of cement paste; but here the Edwards theory of surface-area control of workability, also confirmed by Mr. Young's tests, comes into play. For any given aggregate the field workability is confined in a fairly narrow range by the ability of the cement paste to cover the surface of the aggregate. So long as the cement-water ratio is correct, a consistency satisfactory to a practiced concrete worker will attain the desired strength.

Engineers will recognize the great advantages of such a method of proportioning, provided the theories on which it is based are proved correct. Once having ascertained the constants of an aggregate being used on a job, the quantities of aggregate or of cement and water, whichever is the more simple to control, can be fixed as to delivery to the mixer, and the consistency of the concrete varied almost from batch to batch by the simple changing of the variable ingredient, with the assurance that the resulting concrete will have constant strength. The troubles with the question of wet or dry concrete will be over.

It is not to be assumed, however, that such a millenial day for concrete has unquestionably arrived. There is still much controversy among testing specialists concerning the invariability of the water-cement law, and the crucial determination of a normal consistency is yet to be assured. As to the former, it seems to be the Bureau of Standards against the field, with the indications that within the fairly narrow limits of practicable aggregate grading the law holds. A number of laboratories are conducting tests which should give valuable information in a short time. Normal consistency for the "Hydro" tests is determined largely by eye, but Mr. Young states in his article that he thinks they are on the track of a quantitative determination. Something more consistent than the slump test must be found.

The scheme will work only when other principles of good concreting are followed. It does not relieve the builder of the necessity for having good, clean aggregate and water, of thoroughly mixing the concrete and of providing proper cement. Furthermore, it involves considerable laboratory and field investigation where skill and experience are required in high degree. However, if it furnishes a consistently strong concrete with a saving in cement and settles the water-content problem its general adoption is only a matter of time.

Railroad Legislation

NOW that the President has proclaimed the return of the railroads to their owners Mar. 1, 1920, there is more urgent need than ever for the enactment of an adequate law governing the regulation of the roads. Return on Jan. 1, 1920, as the President had contemplated, would have been followed by serious consequences. With the passage of the Cummins bill in the Senate Dec. 20, the House and Senate will begin to thrash out the differences in their respective measures. The differences are so great that delay would be almost certain were not the situation so urgent.

The Cummins bill bears evidence of a desire to grapple honestly and broadly with a difficult problem. On the whole, the measure presents a better basis upon which to work out a settlement than the Esch bill, passed by the House at the last session, because it recognizes the need of a better adjusted Federal regulation and a more definite plan of ratemaking. Assuming that private ownership and operation will continue, these are the two most important elements of the case. But we doubt that its labor provisions and the limitation of "excess" earnings by a diminishing proportion allowed the carrier would meet with ultimate success.

The Cummins provision creating a Federal Transportation Board, charged with the administration of various operating functions, hitherto thrust upon the overburdened Interstate Commerce Commission, is a step forward. Unfortunately, the Esch bill fails to recognize the need of some kind of Governmental *operating* body, charged with maintaining the efficiency of the transportation machine, as well as a *judicial* body endowed with regulative powers. True, the House bill contains commendable features designed to overcome difficulties by broadening the powers of the Interstate Commerce Commission in operating matters, but it is essentially a move to revert to the old status, with the Commission in complete control and furnished, on ratemaking, only with the old mandate that rates shall be "just and reasonable." The Commission is now so overburdened that it has not been able properly to discharge its present operating functions.

The Cummins bill faces the rate question more squarely than the Esch bill, with the command to the Commission that rates shall in general be made to produce definite returns. But it is to be regretted that both bills do not restrain state commissions from interference in rate matters. The Senate bill, however, wisely provides for Federal incorporation, which would bring about better regulation of finances and eliminate some of the conflicting features of state control.

As to wage disputes, the Esch bill is wholly inadequate in its failure to provide any definite method of adjustment and to recognize, in the make-up of its two labor boards, the great bodies of unorganized railroad employees. In general, public sentiment is inclining toward a stricter handling of the railroad-labor problem, and the Cummins provisions forbidding strikes will get wide support, in the belief that the community has the right to safeguard essential services. In the case of such services as the police, fire-protection and water-supply forces, the need of anti-strike laws is imperative. But there is at least room for doubt that the railroads are in the same category. The opinion is not at all uncommon that a general railroad strike would break down very quickly, with the public the victors. While we favor a strong policy, we believe that from the standpoint of expediency a plan forbidding strikes while the difficulties are under arbitration and allowing, say, three months for negotiations, would have a better chance of success.

It is generally agreed that consolidations of present companies are, within certain limits, desirable, but the Senate provision for making mergers compulsory at the end of seven years will be strenuously opposed by many of the strong companies, previously enjoying more than average prosperity through strategic geographical position. The weak roads will, in general, welcome it. The probability of long litigation should be considered. In this respect the Esch bill is the better, merely extending power to the Interstate Commerce Commission to approve mergers in the public interest.

The greatest objection to the Cummins bill is in the method imposed for restricting net earnings by taking from the companies a rapidly increasing proportion of the net, and its failure more clearly to define "value" as the basis of the 5½ per cent return upon which rates are to be determined. Public sentiment is set upon restriction of net profits of public utilities, but the method proposed gives insufficient recognition to efficiency and ability of management. Value, unsatisfactorily defined in the act, must, in so far as possible, be clearly set down in any measure contemplating fixed rates of return. Moreover, the rates of return, instead of being fixed, would better be made variable on new capital, subject to change at stated intervals and based upon actual conditions of the money market as determined by the Federal Reserve Board or other impartial body. Only in this way can the companies be *assured* of new capital for needed betterments.

In providing for the transition from Government to private operation, both measures temporarily guarantee incomes—the Esch bill for six months with a "revolving fund" of $250,000,000, and the Cummins bill for five months with a similar fund of $500,000,000. But the Esch bill as amended by the House provides that amounts due from the Government as rental shall be set off against amounts advanced by the Government for capital account, funding any additional indebtedness of the carrier at 6 per cent with the principal payable upon demand in five years. Such an arrangement would certainly impose a heavy burden upon the credit of companies without great financial strength.

To hasten agreement between the two branches of Congress, we hope that the President will transmit his promised message on the railroads as soon as Congress reconvenes after the holiday recess. The prospect now is brighter than ever for a successful settlement of the problem. While the undoubted influence of a highly organized and persistent propaganda for the Plumb plan must be considered, the Senate vote of 65 to 11 (just before the passage of the Cummins bill) against the La Follette measure for extending Federal control for two years is significant as well as gratifying. Although the rules of conference, if strictly adhered to, will prevent the addition of new features, we look forward to a report that will embody the best portions of both bills and result in the passage of a final law better than either.

Developments in 1919 in the Use of Machinery for Highway Construction

Progress Made in Determining Types of Plant Adapted to Rapid and Economical Construction—Use of Motor Trucks and Tractor-Trailers for Material Haulage Increases

By C. S. Hill
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MACHINERY was more widely employed last year and in larger plant units than ever before in highway construction. Due to experimentation, unskilled direction and lack of experience in selecting plant, the results were not definite. Toward the end of the season, certain general conclusions began to be drawn. Experience had indicated which types and arrangement of equipment gave the better results. Nevertheless, highway builders will not find in the year's experience a definite answer to any specific question, not even to the question whether extensive machine equipment is wise.

The season, however, did advance highway construction plant practice in one respect: it pointed out the need for most careful coördination between the various items of plant, the introduction of the factory idea. In other words, it directed attention to the plant as a whole, rather than to individual machines or items of equipment. In addition, it helped to establish a broad classification for types of highway plant; it emphasized the importance of skilled direction of operation, and showed up weakness in plant design.

Broad Lessons Learned

In general, the chief advance of the year was the emphasis, above referred to, on the development of complete road-building plants. There was little new in the development of machines as such. The power finishing machine, which came nearest being new, was old, though not previously widely used, and so were other devices that in the last year were generally considered novelties.

Despite the fact that the chief advance of the year was in the direction of properly coördinated plant, the impression must not be given that there was universal appreciation of the idea. There was progress, however, in getting it accepted, and this progress was due to two circumstances: The adoption of large-mileage contracts and the extensive entrance into the field of large general construction companies. The large contract provided the opportunity and, perhaps, the need, and the large contractor possessed the necessary capital.

Progress during the year in determining the best types of plant, like the progress in the coördinated-plant idea, was partial. Four general types were used:

1. First in order of use and in the perfection with which the details had been worked out, was industrial-railway haulage of batches loaded at a central proportioning plant and charged directly to mixers traveling the subgrade.
2. Stationary mixing plants with long-distance haulage of wet concrete onto the subgrade.
3. Portable mixing plants, moved to widely spaced stock piles in succession, with short-distance wet haulage onto the subgrade.
4. The long-familiar paving-mixer outfit charged by wheeling from continuous stock piles on the subgrade.

Classified according to the magnitude of the operation, the first type led, followed closely by the third type; these were the popular plants for large operations of 10 to 20 miles of road, and were in general use for smaller operations also. Generally, the second and fourth types were confined to contracts of about five miles and never to those exceeding 10 miles.

Classified according to magnitude of investment, the first type of plant led in cost, with the second and third types close seconds and the fourth type well in the rear. Classified according to the number of units and the necessity for their close coördination, the types ranked about in the order in which they have been numbered. Classified according to general utility of the equipment, the order was about as follows: The first type of plant had the fewest major units which were suited to other operations than highway construction, the fourth type followed, the third type came next, and the second type had the greatest number of units which could be used for general construction.

Based on last year's records, which is unfair for reasons which are indicated further on, none of these plant units demonstrated great superiority over the others in average output for a season.

Large Versus Small Plants

The fact that under last year's conditions the small outfit suffered so little in comparison of output with that of the large plants, draws attention to the need for skilled management. Let it be clearly understood that in thus comparing outputs of small and of large plants, the latter exhibited much greater *rates* of output, but little, if any, greater *averages*. Better management of the smaller plants was possible under the conditions of acute materials shortage. They could be operated to full capacity when the large plant could not. They could be operated at part capacity at less cost per unit of production. This did not prove that the large plant was inferior; it merely demonstrated that large-plant conditions were necessary for successful large-plant operation.

In emphasizing the conditions required for the use of large plants, last year's experience performed its greatest service to the contractor. These requirements are:

1. Materials supply always equal to the output capacity.
2. Exact coördination of plant units in speed and capacity.
3. Precise routing of materials on the work.
4. Rigid maintenance of all machines in working order.
5. Planning ahead of operations, and
6. Complete recording and analysis of methods and results.

Experience last year, furthermore, made plain the fact that unless these conditions are assured, large-plant construction outfits will fall short of their possibilities and may prove unwise.

To recapitulate, the year's far-reaching developments in machine construction of highways were: Extension

of the practice of the factory idea of coördinated equipment; broad definition of successful plant types, and emphasis on the importance of skilled direction of plant operations.

New Machines and Operations

Strictly speaking, no new road-building machines were developed. Several were new in the sense that they were generally used for the first time last year. Outstanding among these is the power compacting and finishing machine for concrete slabs. For quick reference, the machine development of the year may be considered under: Grading and subgrade preparation; unloading and proportioning of materials; transportation of materials; charging materials and mixing; placing and finishing pavement.

In heavy grading, tractor operation of plows, scarifiers, and grading machines was noticeably increased. The development of a definite practice of substituting tractors for horses in all operations requiring more than one team appeared. With tractor operation an indication also was had of the need for strengthening machines for uprooting and cutting down hard packed material like old macadam and gravel surfacing. For light grading or subgrade preparation there was an increased use of machines for fine finishing in order to meet the growing tendency of specifications to call for profiles exceedingly close to theoretical lines and surfaces. In some specifications ½ in. was the variation permitted. In design of novelty, the subgrade finisher or planing machine stood out most prominently. This machine rides on steel side forms set ahead accurately for slab construction, and is hauled by a road roller or tractor. With skilled operation, the fresno scraper was another successfully used device for close finishing.

Loading-plant practice in 1919 indicated that the ideas of contractors were still rather jumbled. Stationary elevator bins, traveling bins, and stock piles over tunnels, both surface and subsurface, were used about equally, with both locomotive cranes and derricks, and both large and small buckets for unloading. Toward the end of the year, favor leaned to the elevated bin plant. A growing inclination toward traveling bins as advantageous in cutting down switching and shunting operations was also apparent. Bulk handling of cement was the successful loading-plant experiment of the year. The experience of several contractors demonstrated the practicability of (1) safe shipment in open-top cars with tarpaulin covers; (2) unloading without waste by clamshell buckets; (3) storage in open-top bins with tarpaulin covers; (4) charging by measuring chutes without excessive dusting. Careful planning of material-handling appliances is sufficient to make the use of bulk cement entirely practicable in highway construction, with a consequent material saving, if the limited experience of the year is a safe criterion.

Job Transportation of Materials

Job transportation of materials was demonstrated anew by the year's experience to be the crucial task of modern paved-road construction. There were three types of haulage operations: (1) Haulage of raw materials to stock piles in the grade; (2) of dry batch from loading plant to mixer; and (3) wet batch from mixing plant to subgrade. Each of the three operations presented its special problem.

Increased use of motor trucks and of tractors with trailers was the year's new development in hauling material to stock pile on the grade. Success was dependent upon road conditions. Dirt roads in wet weather put the large-load, heavier vehicles virtually out of commission through reduced speed, even when the machines were not stalled. This led, as experience was gained, to the use of lighter trucks. The question whether light trucks, through greater ability to travel soft roads, might not increase the number of trips sufficiently to excel in haulage performance the larger, though slower, heavy trucks, was raised by the year's experience.

Dry-batch haulage to the mixer from a central loading plant, through the use of industrial-railway plant, was general. Gasoline locomotives were the motive power. Batches were carried in boxes on flat-cars or in car bodies removable from the trucks. In detail, the approach to a standard was not so close. Weight of locomotive and of truck, length of trains and size of batches, showed a great variation. The manifest haul was, however, less a lack of uniformity than one of capacity. To operate the modern three-bag batch or larger mixer at full capacity, greater speed was found necessary in carrying materials, and a demand for heavier equipment developed—for six-ton in place of three-ton locomotives; for 25-lb. instead of 20-lb. rail; for 20-car to 30-car trains instead of 10-car to 20-car trains; and for 15-mile speeds instead of eight-mile speeds.

Realization of the vital importance of thoroughly equipped industrial-railway plant, and its efficient operation, was the outstanding feature of the year. As employed on fast road work, the industrial railway is in miniature a modern commercial railway with intensive traffic. Train schedules, train loads, running speed, accident prevention and maintenance are essentials that must be planned, and the plan must be flexible to meet emergencies. The job of traffic manager is a position which this year's experience with industrial-railway haulage has raised to prime importance.

Wet-Batch Haulage Possible

Wet-batch haulage was demonstrated by the year's operations to be an important possibility. Two means of transportation were successful—motor trucks for long hauls and truck-tractors for short hauls. With hauls up to two miles no trouble was experienced in getting the mixture onto the grade without segregation on preliminary set. The disadvantages which were most evident were: (1) That hard roads are essential to continuous motor-truck operation; (2) that motor truck travel over finished subgrade necessitates a second finishing and rolling, and (3) that pumping and road side pipe lines continue necessary for curing the slab.

Toward the end of the year studies of plans for obviating these disadvantages had made progress. Wet-batch haulage by industrial railway was an obvious thought. This plan met the first two disadvantages but not the third. A more original plan was based on the reasoning that if the water in the wet batch could be prevented from escaping by absorption into the subgrade and by surface evaporation, the need of a water-supply on the grade would be eliminated. It was considered that this conservation of water might be effected by oiling the subgrade and by covering the concrete, immediately after finishing, with a thin skin of asphaltic material. Other considerations were the

use of lighter trucks and the use of pneumatic tires.

The mixer experience of the year demonstrated that: (1) For high-speed road construction, mixers of greater strength and endurance in details are essential; (2) a number of mixers are incapable of handling dry mixtures speedily. Without much doubt, the use of dry mixtures will be extended. Whether they will prevail elsewhere than on paper is an open question. Observations of many operations under dry-mixture specifications last year led one to wonder how much of the concrete which went into pavement slab came strictly within the requirements of a 2-in. maximum slump. In the circumstances, then, it may not matter whether great effort is made to improve mixers for handling dry concrete, but the improvement of their strength and endurance is essential.

Machine finishing of concrete slabs was a success wherever employed. It produced a well-compacted concrete and a smooth, even surface. As a labor saver it demonstrated its right to a prominent place among road-making machines, whether dry mixtures or wet mixtures be used. A sturdy side form is necessary, and the year's experience indicated that side forms need to be made heavier to remain firm under the vibrating travel of the finisher and not to develop a permanent set. An observation which merits attention is the action of the machine in flushing to the surface an appreciable depth of mortar above the stone. This is an advantage, or the contrary, as one approves a mortar surface or holds that tough stone, flush with the surface, is essential to resist wear.

Heavier Standards Required

Greater ability to endure continuous hard service is, in general, a requirement of highway-construction equipment. There are individual machines which do not need strengthening, but, in general, weight and strength must be added. The nature of certain operations is such that responsibility rests on a single unit and so, when that unit fails, work stops. Duplication of such units is expensive, but that is not the most disadvantageous feature, in road work, of this ordinarily successful insurance of continuous production. If a mixer has a minor-part breakdown, for example, the time required to move a duplicate machine several miles into the field is seldom less than would be required to repair the break. Duplication of plant is scarcely practicable except in the sense of providing spare machines and parts; and, therefore, road machinery needs to be exceptionally well guaranteed against accident by strong construction. A master mechanic and a repair gang and ample spare parts are further insurance required on every heavily outfitted road-construction operation.

Heavily machine-equipped operations characterized the year's highway-construction methods. Under the conditions prevailing, the year's record of performance did not establish the superiority of large-plant methods. Management becomes a greater factor of success in large-plant operations, and heavier equipment in general is required to guarantee the intensive service which is its fundamental idea. Continuous output requires factory methods in maintaining raw-material supply, in routing operations, and in keeping equipment in working condition. These are the broad acquisitions, from last year's experience, to the knowledge of road-construction plant with which contractors undertake the new year's work.

Enrollment in Engineering Schools Greater Than in 1917

Attendance Little Less Than That of 1918, Which Was Swollen by S. A. T. C.—Only Mechanicals Decrease

TO DETERMINE the present trend of engineering enrollment in the colleges, questionnaires requesting statistics on freshman registration and total enrollment in the five principal engineering courses for the college years beginning in 1917, 1918 and 1919 were sent by *Engineering News-Record* to 95 engineering schools. Of the institutions addressed, 85 answered, and of those answers, 74 contained sufficient information to determine their total engineering enrollment. Only 50, however, could be used to bring out comparisons for the three years in the five major engineering courses.

Engineering students enrolled in 74 colleges in the United States were totaled as follows: 23,167 in 1917; 34,122 in 1918; 33,937 in 1919. The corresponding freshman enrollment for those colleges was: 9,657 in 1917; 16,752 in 1918; 15,172 in 1919. The total enrollment gain of 1918 over the preceding year was 47%, while the 1919 total shows a loss of 0.5% from that of 1918. In the freshman registration of 1918 there was a gain of 73% over 1917; this year's freshman registration was 9% less than that of 1918. The total enrollment gain of 1919 over 1917 is 46%, while the total freshman registration gain of this year over 1917 is 57 per cent.

Although the questionnaire did not ask for it, several of the colleges inserted their 1916 figures, and from those it is estimated that the 1917 total enrollment in the engineering schools was about 25% below that of 1916, with freshman registration for 1917, however, only about 8% below 1916. In considering the large enrollment of last year, then, it must be noted that 1917 was a year of subnormal engineering student attendance. Also, the year 1918 was abnormal in that the Students' Army Training Corps increased both the total engineering enrollment and the freshman registration to an extraordinary degree. The engineering schools were asked for their enrollment figures as of the beginning of each college year and they included therefore the S. A. T. C. students. As the great majority of such students dropped out of their courses shortly after the signing of the armistice, the 1918 totals—as for a college year—are therefore, somewhat "watered."

It is known, then, from present data and from a canvass of the situation made in 1917, that the total engineering enrollment of 1917 was below normal, due to enlistment, the draft, and other causes, and the freshman registration of 1918 was unnatural in its extraordinary increase due to the S. A. T. C. Therefore, for the purpose of gaging this year's total engineering enrollment, 1917 and 1918 should be disregarded and a comparison drawn, instead, with that of 1916. Following that line, it is calculated that the total enrollment of engineering students for this year is approximately only 9% greater than that of 1916. This year's engineering freshman registration, however, is approximately 44% greater than that of 1916. The probable cause of the very large current freshman registration, nearly as large as the 1918 figure as distended by the S. A. T. C., was the delayed entrance of men in, or

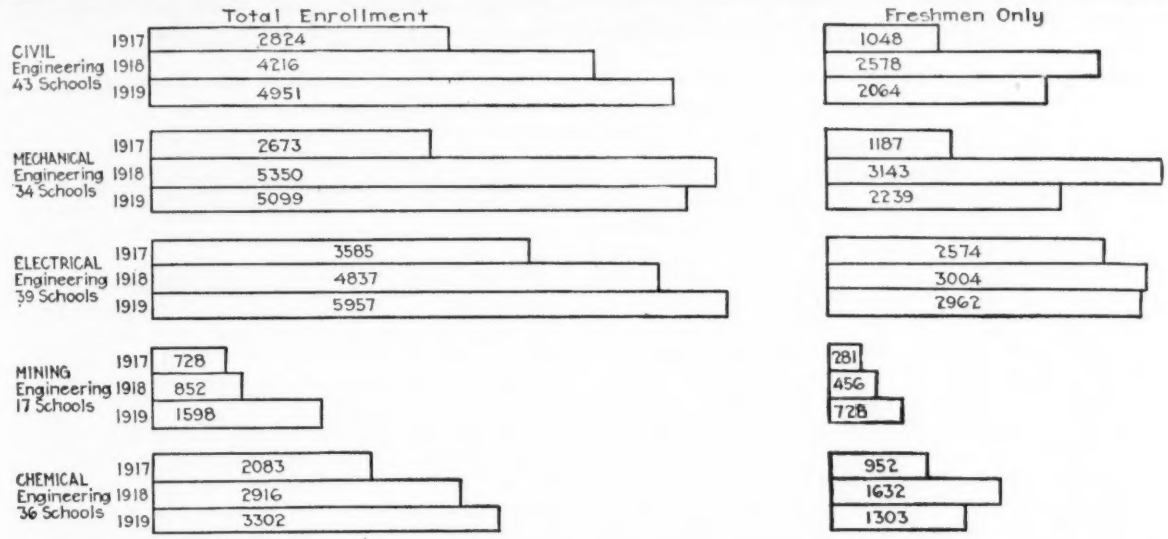

CHART SHOWS RELATIVE ATTENDANCE FOR PAST THREE YEARS IN 43 CIVIL ENGINEERING DEPARTMENTS, 34 MECHANICAL, 39 ELECTRICAL, 17 MINING AND 36 CHEMICAL

connected with, the military service during 1917 and 1918. It would be of value to know what portion of the S. A. T. C. attendance was really normal engineering attendance, but available data do not furnish that information.

In comparing enrollment and registration in the five major engineering courses for 1917 and 1918, the returns from 50 engineering colleges were found available in that they furnished the information desired. Fortunately, too, they are very well representative of the engineering institutions of the United States. The colleges whose information was used in compiling the accompanying chart are located in 29 states, as follows: 19 in six New England and Eastern states; 13 in five Central states; 7 in seven Southern states; 5 in five Western and Southwestern states; 6 in six Rocky Mountain and Pacific Coast states. Not all of the 50 schools offer courses in all five branches of engineering chosen to serve in a comparison; therefore the identity and the number of schools contributing to the total in each branch vary. Also, many of the schools offer courses other than those named in the questionnaire and used in the chart. The students enrolled therein are not included in the charted totals. No comparison in volume of enrollment can be made from the chart between the five branches of engineering, because of the fact that the figures for each have come from a different number of engineering schools.

The only comparisons set forth, then, are within each indicated branch of engineering, and consist of the 1917, 1918, and 1919 total enrollment figures and freshman registration figures for each. It is notable that mechanical engineering is the only branch which shows a decrease in total enrollment from last year. The explanation of such decrease, however, is offered in the excessive freshman registration of 1918, a large part of which, without doubt, was S. A. T. C. membership whose individuals have not enrolled this year. On the other hand, mining engineering is the only branch that shows an increase in freshman registration this year over that of 1918. This also is a circumstance which may be explained by the fact that the mining schools were affected to a very small degree by the S. A. T. C. during 1918. Electrical engineering shows the most consistent growth in total enrollment for the three years, with civil engineering second, mechanical, third, and mining engineering fourth in consistency. Except for mining engineering, electrical engineering had the smallest freshman loss this year, as it also had the smallest percentage of freshman gain last year, which facts are indicative that electrical engineering was less affected by the S. A. T. C. than was civil, mechanical or chemical engineering. It is curious to note that mining engineering, whose total enrollment has more than doubled in two years, has this year a freshman registration exactly equaling its total enrollment of 1917. A summation of the situation is to say that this year's total engineering student enrollment is about 9% greater than that of normal 1916; that electrical, civil, mining and chemical engineering have had consistent growth in enrollment during the past three years; and that mechanical engineering bore the greater part of the S. A. T. C. burden during 1918.

Priestman Wage-Fixing Scheme

A new plan for fixing wages has been devised by a firm manufacturing machinery in London, England. Information regarding what is called the Priestman scheme is contained in a recent issue of *Commerce Reports*. It was only recently made public by the Higher Production Council of Great Britain.. By this new scheme a standard of production is established; that is the amount of work produced by the ordinary effort of a certain number of men, this standard being the basis of pay. Through increased individual effort this standard can be exceeded, and every employee receives a percentage on his wages for all output in excess of his standard. It is explained that the friction often caused by piecework is thus eliminated, and a maximum output is more possible. The Higher Production Council describes the scheme as the "solvent of many, if not all, of the difficulties now facing industry." The firm initiating the scheme has increased its average output by 50% through the operation of the scheme.

The Railways—Financially and Physically

A Review of the Railroad Situation by a Student of the Problem Who Has Had Experience in the Financial, Operating and Engineering Departments

FACING the end of Federal control Mar. 1, 1920, the date set by the President in his proclamation issued Dec. 24, the railways today, like many veterans of the war, are "shot full of holes," "shell-shocked," "gassed" and all but ruined, financially, physically and morale-ly. It has taken ninety years to build up the splendid organization of our transportation systems, but in two short years that system has been disorganized, dismembered and disfigured to such an extent that it is scarcely recognizable. This is due directly to the centralization of control, which has taken away from the practical and efficient operating officials in the field the authority and initiative necessary to produce results. It will take years to recover from this condition.

The attempt to revise almost instantly the operation of 250,000 miles of railway, employing 2,000,000 persons, was an impossible task. The experiment has been proved not only expensive to the public but detrimental to our national prosperity. The necessity of operating the roads primarily in the interest of winning the war was paramount, but it would have been accomplished more effectively, at greatly reduced cost and without the disorganization of the railway systems, if it had been intrusted to a war board of eminent railway men, such as had control prior to Federal control, subject to the general supervision of such Governmental authority as may have been deemed essential to carry out the general policy of the Government.

The reorganization of the railways under Federal control by the appointment of regional directors, some of them charged with the operation of 130,000 miles of road, as was the case in the original Western region—later divided into three regions of about 45,000 miles each—was an impracticable plan. There is no man, however competent, who can possibly supervise such tremendous operations. The organization on so vast a scale broke down of its own weight. How much simpler it would have been to appoint each president as Federal manager of his own railway, with organization undisturbed, and give him the necessary authority, under a general, well defined policy, subject to a central board or commission of eminent railway men.

Where the Railways Stand

The railways find themselves at the end of two years of Federal control in the following unenviable situation:

Financially, their credit is seriously affected and they are, therefore, unable to finance their obligations, except by the aid of the Government.

Physically, their property and equipment are in a depreciated condition; recovery to the point of rendering adequate service to the public will require years.

In organization they are dismembered and disrupted; morale and discipline are seriously affected.

As for labor, last but not least, the roads are saddled with a burden imposed by national agreements with labor organizations which are so drastic in many respects as to be almost prohibitive of reasonable operation.

One ray of hope remains—that the public has had its lesson in the results of Government ownership and operation and will want none of it. If the experience of the past two years has prevented the calamity of Government ownership, it is worth the cost.

Financial Status

It was expected that railways, generally, would be able to finance their obligations under Federal control, provided their "standard return" was promptly paid and the results of operation indicated that at the end of Federal control the net results would be sufficient to guarantee the necessary funds.

The failure to make contracts promptly with the roads, coupled with the unsatisfactory financial results of operation under Federal control, soon made it difficult for the roads, many of them strong ones, to secure funds except through the aid of the Government. It was thought that the increase in rates would remedy the difficulty and produce net earnings sufficient to reestablish confidence in railway securities, but unfortunately the amount yielded by the increase in rates was absorbed by the increase in wages given railway employees, so that the deficits continued. It was also believed that if the Railroad Administration had early come to the relief of the roads in financing their needs, credit would have been maintained and financing could have been effected without Government aid.

The result, however, was that most of the roads were obliged to depend upon the Government for financial aid, which wiped out the first revolving fund and made another appropriation necessary. When it was found that the rate increases were all absorbed by increased grants in wages, prudence should have suggested a further increase in rates to make Government operation at least self-sustaining.

The credit of the roads, at the end of Federal control will be such as to make future financing, for most of them, an extremely difficult matter unless Congress makes provision to strengthen their position by adequate revenue and takes care of the obligations now due the Government from the roads.

As an illustration, most roads finance their additions and their betterment and equipment expenditures by issues of long-time securities. Surplus from earnings is not sufficient to meet the needs currently. Now if the roads must pay the Government out of their standard return, which represents their earnings, many of them will be out of funds. The Government must assist the roads in strengthening their impaired credit; otherwise their financial structure will be seriously affected, with disaster to the country.

Physical Condition

The railways find themselves at the end of Federal control, as compared with the beginning of that period, in a depreciated physical condition with respect to roadway, tracks, structures and equipment. During the first year of Federal control, due to the heavy demand for war purposes, the railways were taxed to the limit to perform their functions, and on account of shortage of labor and material the maintenance of the properties and equipment was below that of the average of the

"test period" (the three years which ended June 30, 1917). During the year 1919, on account of large deficits in operation, expenditures were curtailed in all directions, thereby adding to the deficiency in maintenance, so that the properties are in a greatly depreciated condition. As illustrating the serious physical condition of the roads, a few important items may be mentioned:

Rails—Normally it requires about 2,000,000 tons of steel rails per annum to meet the needs of the railways. The Railroad Administration has purchased directly only 200,000 tons of steel rails in two years, or 5 per cent of normal requirements. The corporations, fortunately, had some unfilled orders at the beginning of Federal control, otherwise the situation would have been even more critical.

Ties—The railways require annually about 100,000,000 ties. From present indications there will be a shortage, during the Federal-control period as compared with the test period, of about 25 per cent, or 50,000,000 ties.

Structures—There has been a large decrease during Federal control in maintenance of structures, such as bridges and buildings, fuel and water stations, largely due to shortage of labor and material and, during the past year, to curtailment of expenditures which in the aggregate will amount to millions of dollars.

Equipment—The Administration has purchased only 100,000 freight cars in two years and only about 90 per cent of these have been delivered. During the four years immediately prior to Federal control the railways built an average of 100,000 cars per year. The average retirement of freight cars amounts to about 80,000 cars per year, so that the Administration has purchased only about one-half as many cars during Federal control as was done by the corporations prior to Government operation, and for the past two years the retirements will exceed the replacements by about 60,000 cars. In addition to this, the freight equipment has not been maintained in normal condition, which means that at the end of Federal control there is not only less freight equipment but that much of it is unserviceable. With the large increase in tonnage which should be handled in 1920 and the probably prosperous succeeding years this situation is a serious one and will result in an extreme car shortage, with a detrimental effect upon our reconstruction period. It will require about 200,000 new cars in 1920 to make good the deficiency.

Locomotives—The Administration ordered 1415 new locomotives in 1918 and later 600 additional, or 2015 in the past two years. These locomotives have not all been delivered to date. The normal requirements are approximately 3000 additional locomotives per annum. During Federal control only 2000 locomotives have been added, or about one-third the normal requirements. It is difficult to see how the traffic of 1920 can be handled with the present locomotive equipment. Moreover, the power has not been maintained in as good condition during Federal control as prior thereto, due to the same causes as apply to freight-car equipment.

Passenger Cars—On June 30, 1916, in the Test period, the total passenger-car equipment consisted of 54,774 cars, and in December, 1918, it was 55,697, or an increase of only 923 cars. On account of troop movements, passenger equipment was so intensively used during the test period that it was not possible to release it sufficiently for necessary repairs, with the result that there is a large depreciation in its condition at the end of Federal control. The requirements for new passenger equipment will be at least twice the normal for the year 1920; in addition, the deficiency in maintenance of present equipment must be made up.

Improvements and New Lines

During the first year of Federal control, 1918, the Administration had an ambitious program for additions and betterments, totalling about $1,250,000,000, but, owing to the shortage of labor and material, less than 40 per cent, or $430,000,000 was expended during that year. (In 1917 $572,000,000 was expended by the railways.)

During 1919, following the armistice, the additions and betterment program was largely curtailed, owing to the heavy deficits in operation and depletion of the revolving fund, and it is estimated that less than $300,000,000 was expended in 1919.

In some instances, improvements which were uncompleted were discontinued, and in others cancelled entirely. Much improvement work was stopped, owing to the requirement by the Administration that the corporations should finance the work from their own funds, which they were unable to do, owing to their inability to finance themselves. The result has been that in the two years of Federal control only about one-half the normal expenditures will have been made on improvements. In order adequately to meet the transportation needs of this country, from $1,000,000,000 to $1,500,000,000 will be required annually for the next five years.

In the matter of new lines and extensions, less mileage was added in 1918 than in any year for the past thirty years. Only 721 miles were built, of which 55 miles was in Alaska. Most of the mileage built was projected by the companies before Federal control. In 1914, 1500 miles, and in 1915, 1916 and 1917 approximately 1000 miles were built each year. There has been no incentive for capital to invest in railways, owing to the ever-decreasing margin between revenue and expenses, due to the mistaken policy of the Interstate Commerce Commission respecting rates.

The single-track mileage reported in operation Dec. 31, 1918, was 250,473, as against 252,029 on Dec. 31, 1917, a decrease of 1556 miles.

There are many regions sorely in need of transportation facilities which cannot be provided, owing to the unsatisfactory financial situation confronting the roads. The oil regions of Oklahoma and Texas are today restricted to about one-half their capacity output because of lack of transportation facilities. Many similar cases will arise when the country resumes its normal activity. If the railways cannot profitably operate their present mileage, whence will come the capital to provide additional lines?

Railway Labor Situation

The Director General, at the beginning of Federal control, encouraged railway employes to organize, to present their demands and make agreements covering wages and working conditions. Labor is entitled to a fair deal, but when that condition is met it is time that the public, including the owners of railways, should have consideration.

In May, 1918, General Order 27 was issued, and since that date numerous supplements, addenda and interpre-

tations thereto have appeared. As the result of these increases, the annual cost of railway labor is advanced to approximately $1,200,000,000 over 1917. If the element of inefficiency of labor now, as compared with the pre-war period, is considered, it means that the annual labor cost is increased about $1,500,000,000 over 1917.

The total interest charges on funded and unfunded debt of the United States railways for 1917 was $431,000,000, and in 1918 $434,000,000, which means that the annual increase in wages to railway employees made during Federal control is equal to three and one-half times the interest on the indebtedness of the properties.

The dividends paid in 1916 on roads now under Federal control amounted to $337,000,000, or less than one-fourth the amount of annual increase in wages under Federal control.

The aggregate of interest on bonds and dividends on stock per year amounts to approximately $750,000,000, or about one-half the increased cost of labor per year under Federal control as compared with private control. In brief, the combined returns to capital of $18,000,000,000 invested in our railways is only about one-half the annual increases granted to railway labor under Federal control.

Why There is a Deficit

These are startling statements, but they are facts. They alone are sufficient to explain the large deficit in operation during Federal control.

The increase in freight and passenger rates made in June, 1918, is equal to about $900,000,000 per annum, and it was expected that this would meet the increase in wages to railway labor. The increased cost of railway labor alone will be easily one and one-half times the increase in rates.

Even in the face of these pertinent facts, the Director General has declined to ask for further increase in rates, because he thinks such a request would affect the cost of living, yet at the same time new increases in wages and working agreements are being made. These are burdens under which the railways must struggle when they are returned. It is the evident purpose that every craft and employee on railways shall be thoroughly organized before the end of Federal control. The conditions which are being included in these agreements are in some instances so impracticable as to be unworkable, except at prohibitive increases in labor costs. The practice of allowing "back pay," which in many cases was not expected, has cost the Administration several hundred millions, contributing to the deficit which the patient taxpayer must meet.

Railway labor receives higher pay here than in any other country. The total amounts to 54 per cent of the gross revenues. In England labor receives only 34 per cent of the gross. The compensation of American railway machinists has increased 135 per cent in the past three years. Moreover, the annual increase given railway labor during Federal control is about one and one-half times the standard return paid to the railways by the Government for the use of their properties. It is readily seen why the railway labor organizations demand a continuance of Federal control.

If railways are not given consideration, by increased rates, to meet these enormous increases in costs of operation, there will not be a solvent railway within a year after Federal control ends.

The railway problem is very simple if reduced to its lowest terms. No business can live if the expenses exceed the revenues, and it is plain that this condition confronts the railways at present. Unless an immediate increase in rates is given they cannot perform their functions.

The increase of 25 per cent in freight and 50 per cent in passenger rates has not been sufficient to meet the increase in wages and cost of materials. It can be easily determined what further increase in rates is necessary to meet the requirements. It is very evident from the situation outlined above that at least a further increase of 25 per cent in freight rates is necessary to make up the deficits in operation and give a fair return on the capital invested. If this were done, the railways would take care of themselves and the entire problem would be solved.

The Cummins bill which has just passed the Senate is a step in the right direction, and although in many respects imperfect, it would meet the situation until experience makes changes necessary. But the Cummins bill is so vastly different from the Esch bill, which has passed the House, that it may suffer changes in conference so radical that the amended measure will not meet the situation.

If the railways are returned without provisions to enable them to earn enough revenue to carry themselves a financial situation that will seriously affect the whole nation will be created. If the railways are properly provided for, the country will forge ahead and profit by the greatest industrial expansion that has ever been known.

The future of the railways and the welfare and prosperity of the country are so inextricably bound together that whatever be the fate of the former must be the fate of the latter. It is confidently expected that the great common sense of the American public will assert itself and insist upon a square deal for the railways.

Traffic on New York's Transit System

More than 2,000,000,000 persons rode on the elevated, subway and trolley lines of New York City during the fiscal years 1918 and 1919, according to figures compiled by the Public Service Commission for the First District. This is the largest traffic figure in the history of the city and represents an increase of nearly 104,500,000 over the previous fiscal year. Only two other years exceeded 1918-1919 in the amount of increase in traffic. Had it not been for the ravages of the influenza epidemic in the fall of 1918, it is fair to assume the increase for 1918-1919 would have been greater than in any other year, inasmuch as the increase from December, 1918, to June, 1919, inclusive, was 122,500,000. From this total, however, must be deducted a loss in traffic for the first five months of the fiscal year amounting to 17,000,000 passengers, of which the loss was 12,000,000 in October. The total increase was divided, 98,751,618 for the rapid-transit lines and 5,679,197 for the surface lines. The percentage of increase for all lines was 5.29. On the rapid-transit lines the percentage of increase was 8.93 and on the surface lines 0.65. The increase in passenger traffic brought a corresponding increase in revenue; but this latter increase was offset by operating expenses, which increased at a very much higher ratio, causing all the companies a total deficit in net income of $8,085,019.

Present Status of Flood Protection

By C. B. Burdick
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THE great floods of 1913 brought to a head many projects for flood relief that had been receiving more or less attention for many years. A great disaster was required to furnish the impetus necessary to carry the projects to the construction stage. The lesson, though costly, was sufficiently effective so that a start has been made on the construction program.

The Miami Conservancy District is going ahead courageously, in the face of the recent higher prices, with its program for detention reservoirs and channel improvements, running into upwards of $25,000,000, estimated on a pre-war basis. Columbus is at work upon its program for expending $3,500,000 to secure partial protection by enlarging the Scioto River channel within the city. Erie, Pa., is proceeding with structures for protection against the floods of Mill Creek, and Augusta, Ga., has just completed a $2,000,000 expenditure for levees. At Kansas City, the Kaw Valley Drainage District, through ten years of litigation, has succeeded in greatly improving the channel of the Kansas River within the city, including reconstruction of the numerous bridges and building of levees. This work has not reached the stage where complete protection is effected, and in the past winter voters turned down a $1,600,000 bond issue to complete the protective works.

Progress Made in Solution of Problems

The publicity occasioned by the great Ohio floods and the thorough studies which followed no doubt have served to direct other localities to the consideration of similar problems. While most of these problems have not as yet progressed beyond the investigation stage, advance is being made toward the solution.

In the St. Louis district, the City of St. Louis has prepared plans to inclose River Des Peres where it passes through the city, draining 110 square miles, largely suburban and rural territory, estimated to furnish about 40,000-sec.-ft. in flood. Across the Mississippi, at East St. Louis, the East Side Levee and Sanitary District has just completed studies which will solve the problem of the floods originating in the district, and upon the hills behind it, requiring improvements estimated to cost in excess of $2,000,000. Decorah, Iowa, presents an opportunity to construct a small detention dam which will protect the city against floods of Dry Run at a relatively small expenditure. Council Bluffs, in the same state, is another city where a small stream finding its outlet from the hilly country through the business district has caused damage and nuisance for two generations. It is expected that construction will be undertaken to the extent of about $1,000,000 during the coming year to correct this situation.

The recent studies of the detention basin, and the added knowledge in reference to floods that has been obtained in recent flood investigations, have made it desirable that some old problems be reconsidered in the light of later data. Every year something is added to the store of knowledge relating to the computations of floods and the measures for correcting them. Engineers will perform a valuable service to their communities and to engineering in general by measuring floods where the opportunity is offered, and assisting to record the related data that will make the information most useful to the science of hydrology. Progress is to be looked for in more extensive installation of rain gages and stream gages, and compilation of systematic records therefrom. Information relating to the storms and floods of watersheds of moderate size (say from 500 to 5000 square miles) has already been greatly increased through the Miami and Scioto studies. More information is needed concerning the watersheds of 100 square miles and less, which are affected by storms of an entirely different character.

Large Contractors Seek Reforms in Highway Contracting

First Season's Experience Proves Unsatisfactory—Higher Prices Must Be Asked if Present Conditions Continue

By C. S. Hill
Associate Editor, *Engineering News-Record*

A SEASON'S experience in actual construction has strengthened the conviction of large construction companies that changes are necessary to make highway contracting attractive. These companies assert that road contracting in 1919 has not paid; that construction progress has been unprofitably slow, and that, with conditions as they are, many organizations which have undertaken road construction in 1919 will not undertake further contracts except at increased prices. However, they say, furthermore, that with conditions changed in ways which they believe are open to road officials, increased prices may be unnecessary for a reasonable profit and progress may be accelerated.

As disclosed by inquiry last spring (*Engineering News-Record* of June 12, 1919, p. 1150), the disposition of managers of large contracting organizations was to undertake highway work as a stop-gap until construction activities were resumed by the railways and other private industries normally providing heavy construction contracts. The politics, narrow business practices and petty contract restrictions of highway work were cited as objections to permanent engagement. Six months' operation as indicated above has not greatly modified the original attitude of large contractors, but it has enabled them to estimate more accurately the strength of the various obstacles to profitable contracting which present conditions impose and to formulate somewhat precisely the changes in practice which are deemed essential.

Changes Specified

As formulated in the minds of construction managers, the changes needed to improve highway contracting conditions are classified under the following: Contract practices, materials supply, and plans and specifications. The points here made have been gathered in conference with contractors. Most of them have also been put forth in a memorandum addressed by the Associated General Contractors of America to the American Association of State Highway Officials.

To attract large construction organizations, highway contracts should be let in as large mileages as are practicable and should extend over more than one season. That in awarding contracts there should be the most careful investigation of the contractor's experience, organization, past performance and financial ability, and award should be made only to a contractor whose ability to accomplish the work, giving due consideration to its magnitude and difficulty, is beyond

reasonable doubt. Contracts should comprise all work on the project—grading, paving, bridges and culverts—and should be let undivided. Until it has been definitely decided to undertake construction, bids ought not to be asked, and when bids are received contracts should be awarded within 10 days. If all bids are rejected, the lowest bidder should receive, as compensation for his estimate, ½% of his estimated cost of the work. Under present practice, flagrant abuses exist in asking bids merely to obtain prices and in holding guarantee checks for weeks and sometimes for months. Since large highway construction operations call for extensive preparatory work, assembling plant and materials and formulating construction plans, contracts should be awarded in the autumn, to insure an early spring start of construction.

State aid in obtaining materials, and not state supply, meets greatest favor from large contractors. They ask, therefore, (1) that state supply of materials be discontinued; (2) that the use of local aggregates be encouraged by materials surveys; (3) that estimates be allowed on materials in stock pile and be based on the total cost of materials and of handling; (4) that, whenever it is practicable, state inspection of road materials should be at the source, and (5) that highway departments should bring their full influence to the aid of the contractor in obtaining cars for the shipment of road materials.

To get close estimates, plans should be accurate and complete and should be ready for the contractor at least three weeks in advance of the date of receiving bids. Whenever changes in plans, after the contract is awarded, require increased work or involve delay, the extra work and the time lost should be paid for. On force-account work, the percentage paid the contractor should be computed on the total cost. When work is turned over to public use, it should be accepted and paid for in full, and the contractor should be relieved of responsibility for maintenance. Retained percentages should never exceed 10% of the cost of the contract.

None of the changes which have been enumerated, it is contended by contractors, asks of highway officials anything which engineering practice has not sanctioned. It is possible to demonstrate by examples that each one relates to a condition where abuses exist. All are considered to be mutually for the benefit of the public whose money is being expended, of the engineers who are directing this expenditure, and of the contractors.

Contractors Must Control Work

Coördination of operations is absolutely essential to economical and uninterrupted progress in constructing paved roads. Divided control of operations hinders coördination. Control is divided (1) if one contractor performs certain units of the work and another contractor performs the remaining units; (2) if one party to a contract furnishes the materials and another handles and places them. The large construction companies, therefore, desire contracts covering all structures involved in any piece of road work, and object to any policy by which road officials furnish cement or aggregate or any other major construction material.

State-furnished materials have, it is considered, proved a drag on progress. The ordinary highway department functions slowly. It is chiefly concerned in getting the material at lowest cost. It is hobbled by red tape when emergencies demand quick action. It has no clear way of expediting movement by taking advantage of spot material at a price advance.

The contractor is restricted in none of the respects named. He is not wholly concerned in getting his material cheaply. His objective is finished construction, and if a premium wisely disposed helps, by expediting materials delivery, to finish construction more rapidly, he wants the unrestricted power to adopt that resort. He wants to buy when and where he pleases; to concentrate or to distribute his orders; to demand and to grant concessions. Unless there is this control, one of the chief functions for which his large organization has been perfected is taken away, and the power of the large contractor to conduct large operations is nullified.

State-furnished road materials, the large construction companies consider, is a close second to the "lowest-bid" doctrine in encouraging the tyro in contracting. These conditions, in some sections, it is pointed out, have ruined the credit of road contracting. They are multiplied by every additional action which makes contract getting easy, and state purchase and supply of materials does this. The theory that by throwing wide the doors to road contractors, the program of road construction is speeded up is held false. What is required from the state is not generosity in bestowing contracts but aid in helping the proved contractor, who has work, to hasten construction and earn a profit.

Modify Plans To Meet Emergencies

Unless road officials exercise their discretion, as railway engineers and the engineers of other large employers of contract work do habitually, when the emergency arises, to modify the letter of the specifications, in order to simplify an immeasurably greater problem, the large general contractor contends that he cannot do road work at last season's contract prices and will withdraw from the field as fast as opportunities offer themselves in his original fields of activity. Claims urged by highway officials that they cannot delegate such important discretionary powers to the ordinary inspector, or think it unsafe to permit their exercise by any except the most competent engineers, are met with the final contention of the contractor:

More engineers and salaries great enough to secure the best trained engineers must be provided in order that: (1) Plans for construction shall be completed well ahead of contract lettings, which is not being done; (2) plans shall be complete and accurate, which is not now the fact; (3) decisions affecting speed and profits shall be rendered promptly and finally, which is not now the practice.

In general, then, while a goodly number of large contractors heretofore specializing in other lines have taken highway contracts during the past season, their experience to date has not led them to the conviction that they want to stay permanently in road contracting. Conditions are still far from being as satisfactory as those found on private work. The large contractors, seeing the large program of highway work ahead, are desirous of seeing such reasonable changes made as will allow them to regard highway work as one of their specialties. But unless the changes which to them appear reasonable and possible—because the desired conditions obtain on private work—are made, they will return to other lines as rapidly as they can.

Engineering and Adventure—

A Plea for a Return to Individualism as Against an Overdose of "System."

By P. B. McDonald
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MANY young men choose engineering as a profession because it suggests adventure. Young men of Anglo-Celtic ancestry are particularly inclined to seek work that interests them, rather than to reconcile themselves to the laborious plodding that characterizes German method. The yearning for adventure is perfectly natural and fitting in a young American—or, for that matter, in an old American. The man who discovered America took a chance, as did the early settlers and pioneers, and it is not strange or discreditable that their descendants should hanker for the unknown, the far-away, and the romantic.

Yet the vigorous young graduate from an engineering college finds his superiors advising him to settle down and form a rut. Industrial officials frown upon adventure. To them an adventurous spirit is the cause for making machinery "foolproof." The young graduate is put to counting cars or copying maps or sampling ore-bins. This is the "valuable experience" which is to compensate for his small salary. His spontaneity is deadened, and he comes to consider his youthful ideas of engineering as all wrong. Perhaps a few years of drudging so sour him that, when he becomes a boss, he takes out his bad temper on the young graduates who come to work under him.

More serious is the effect upon workmen of putting them in charge of a boss who has become constitutionally opposed to anything interesting, different or adventurous. Ruskin pointed out many years ago, with that strange capacity for seeing into the future that some Victorians possessed, that the subdivision of labor when carried to extremes would make for unrest and discontent. A man that spends his days and years sharpening the points of pins is likely to provide receptive material for bolshevistic theories, even though his wages seem high. That same man's ancestors worked longer hours for smaller wages, but took their work more leisurely and saw more of interest in it, because their tasks were varied and invited originality. Writers on the Middle Ages tell us that in the Merrie England of that period men left their work reluctantly and dreamed of their plans for the morrow. The Gothic cathedrals are beautiful and inspiring because the workmen were allowed to express themselves. The work was not drudgery. Every trade had a guild, somewhat in the manner of the modern trade unions, but the spirit of labor was quite different from that of today.

The point is that it may not be entirely the fault of the employee if he is discontented. The employer has thought very little, if at all, about making work interesting for his subordinates. In the case of engineers, officials seem to take a malicious pleasure in showing the young man that there is no adventure in engineering, that it is all a sordid grinding of the nose, that spontaneity and originality are faults, not assets.

Of course, the employers are partly right. Life does not consist of always running to a fire, as Woodrow Wilson has pointed out. Much youthful enthusiasm is misdirected and sophomoric. But engineering, or life itself, need not be entirely a grind. If work can be designed to utilize the spirit of advanture inherent in American youth, the greatest possible effort should be made to permit the expression of such desires. As C. R. Mann says concerning engineering education, "the fundamental thing is to get the boys to want to do it."

The brief military experience of the United States during the late war showed very well what a difference enthusiasm makes. While there was a chance of adventure, young men were eager for the Army and would do marvels; after the armistice was signed, everyone was anxious to be discharged as soon as possible.

Speaking generally, adventure is a state of mind. A fat man living in a back street in Brooklyn may have it, while a young fellow traveling among gold mines and opera bouffé and señoritas may be absorbed in getting back home to the old, familiar routine. Probably the fat man would be the more interesting to work for. In reading the articles contributed to technical periodicals by prominent engineers, it is not difficult to distinguish those that see work in the light of romance and those that see only the grindstone. According to the blue laws of people of no imagination, the more dry-as-dust an engineer is, the more successful he is. Such, however, is not always the case, as is shown by the records of engineering life.

Engineering as a profession should invite creative imagination, diverse individualities, men with new ideas. There is no profession offering more real opportunities for adventure if properly encouraged. Engineering can take men to the ends of the earth, to exotic, colorful places where romance is in the atmosphere and each day is an adventure. The engineer in his laboratory is frequently probing the unknown, and, if his time is not taken completely for routine, he can adventure into worlds as interesting as those to which the traveler goes.

H. G. Wells (who occasionally has a bright intuition) maintains that, instead of the world being made "safe for democracy," it should be made as favorable as possible for personal adventure. People need adventure, and the nation which best supplies its people with opportunities for attaining their aspirations, both conscious and unconscious, will grow most powerful and persist the longest. A. J. Balfour suggested in one of his essays that the real cause for the downfall of Rome, of which dissipation and vice were only the outward sign, was that the ideals foisted upon the Roman people by its government were too Oriental to satisfy Western minds. American industry, likewise, may have become too Prussianized.

Perhaps the English people have best understood the desirability of encouraging the natural craving for adventure. Their financiers have taken chances in all parts of the world on all kinds of ventures. They have not been afraid to speculate in rubber in the East Indies or Africa, in tea in Ceylon, in railroads in South America, and in gold mines in any part of the world. A Harvard professor recently suggested that one reason why London deals in more commodities than does New York is that the American investor will not take the chances that an English investor will. The variety of stocks traded on the New York exchange is narrow compared with the extraordinary range of interests on the London exchange. We are not so adventurous or so individualistic as the English.

President Hadley of Yale pointed out in a recent ar-

ticle that for the past two decades a decided reaction has been evident against the extreme individualism of Herbert Spencer and other nineteenth-century writers. Individualism was criticized as being too eccentric and irregular. Dependable mediocrity became the policy of great industrial companies that had been made possible by the individualistic efforts of men of the previous generation. As Carlyle caustically remarked, "the end of the nineteenth century was characterized by the appointing of committees." Responsibility and authority became divided and dissipated, in some cases so thoroughly that many great enterprises took on the appearance of bureaucracies. A customer writing to a large firm about a trivial matter was likely to be "referred to clerk 85 of department 207," thence to another official of another department, and so on. Methods of German organization were copied and adopted, and men of pronounced individualistic mind were frowned upon.

This was the time when engineering ceased to be adventurous, and when the chief effort was directed to reducing life to the dull level of sharpening the points of pins. The men encouraged and promoted were the prosaic, obvious ones ranking above their fellows only in pushfulness and thick skins or a tendency to be deferential to those above. Even the most famous American inventor of the time came out with a dictum that genius was "perspiration, not inspiration," disregarding the suggestion of the ancient Greeks that a thing well done is done easily, overlooking also the important matter of natural adaptability and the advice of such leaders as Woodrow Wilson who recommend young men to follow their enthusiasm.

In an industrial democracy such as the United States, the men in control of the country's industries are, in a way, the ruling class. The permanence of what they build depends on the nature of the young men whom they train to take their places. In too many cases it appears that the men advanced in authority were picked for the immediate gains that they could show and not enough for the ultimate effect on the business. Men of narrow mind were advanced in the industries to increase temporary profits, at the expense of ultimate trouble in the form of labor unrest and general discontent. Such a policy is better in the flower than in the fruit.

It is too much to hope, of course, that industrial leaders shall be philosophers in the sense that Plato wished kings to be philosophers, but it is not a radical suggestion to recommend that the men chosen to direct important industries and undertakings should be somewhat broader in views than has been the case of recent years. There should be a return to individualism to the extent that recognition be made of the need for capable leaders and diverse personalities. Genius and talent, even in industrial fields, are liable to be capricious, and everything cannot be reduced to a system; even Henry Ford has remarked that there will always be some things on which we have to take a chance.

As applying to young engineers, the point is that rather than encourage them to settle down when their natures are opposed to it, employers should give some thought to turning youthful enthusiasm to legitimate effort without making the engineer into an engine. More of the present labor unrest than is generally recognized is the result of the mechanizing of work and of the application of the wrong kind of "efficiency."

Cost to Live Increases 73 Per Cent

According to a research report recently published by the National Industrial Conference Board, the cost of living, including food, shelter, clothing, fuel, heat and light and sundries, has, during the past five years, increased 73%. That five-year period is between July, 1914, and July, 1919. The basis for the determination of such a percentage increase in the cost of living is a study of the experiences of more than 11,000 families. The United States Bureau of Labor Statistics and other authoritative agencies reported before the war that the percentages of income spent on those items entering into the family budget were:

Food	43%
Shelter	18%
Clothing	13%
Fuel, heat and light	6%
Sundries	20%

The percentage increases found in separate items are:

Food	90%
Shelter	28%
Clothing	100%
Fuel, heat and light	57%
Sundries	63%

By combining the percentages of increase in the cost of the separate items an advance of 73% is found.

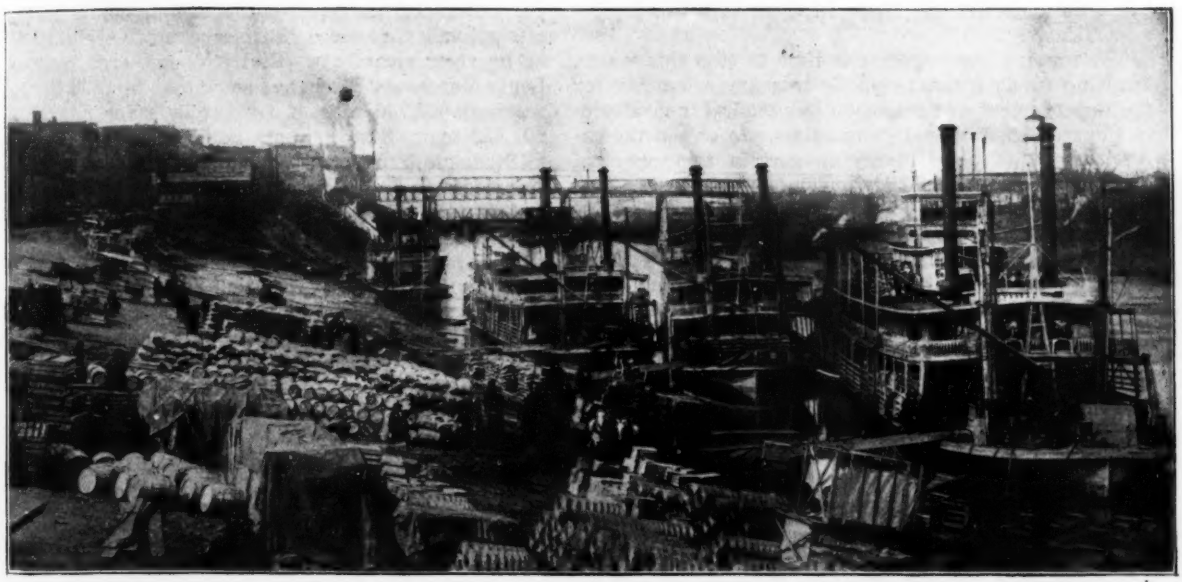
Comparison of Engineering Work and Salaries in Pacific Coast Cities

The accompanying table, showing the salaries that are received and the work that is performed by engineers and assistants in 13 California cities and in Phoenix, Ariz., was compiled recently by Arthur H. Adams, of the Department of Public Works, Long Beach, Cal.

City	Salaries per Month: City Engineer	Deputy Engineer	Chief Draftsman	Draftsmen	Chief of Party	Transitman	Head Chainmen	Rear Chainmen	Stenographers	Street and Sewer Inspectors, per Day	Estimated Population, 1919	Assessed Valuation	Value of Improvements, Year 1919 to Date	Value of Proposed Improvements, Current Year
San Francisco	$1250	$350	$225	$150-175	$225	$165	$165	$125	$125	$6.00	600,000	$805,000,000	.....	$1,000,000
Los Angeles	416.67	300	225	115-155	135-155	110-135	95	85	80-125	4.50-5.00	630,000	622,045,550	$817,374	6,669,342
Oakland	375	275	185	150	215	160	125	125	100	5.00	215,000	150,000,000	.....	.....
San Diego	300	175	175	120-150	150	140	100	95	130	5.00	100,000	78,790,000	.....	.....
Sacramento	300	175	5 per day	4 dy.	6 dy.	6 dy.	100	100	100	4.00	75,000	70,000,000	.....	.....
Berkeley	300	175	160	....	....	135	100	85	125	4.00-5.00	70,000	46,000,000	20,000	.....
Fresno	300	200	6 dy.	....	150	....	4 dy.	....	3 dy.	5.00	60,000	32,000,000	355,300	725,000
Stockton	250	150	....	5 dy.	6 dy.	....	4 dy.	4 dy.	....	5.00	50,000	54,000,000	281,800	.....
Pasadena	250	185	150	135	150	135	100	100	115	6.00	45,000	66,451,397	.....	90,641
Alameda	250	175	....	6 dy.	6 dy.	5 dy.	4 dy.	4 dy.	100	.....	32,000	21,000,000	30,000	40,000
Phoenix, Ariz	250	175	165	150	165	125	90	90	110	5.00	30,000	.....	.....	.....
Santa Barbara	225	150	130	104-117	117	104	91	75	85	5.00	20,000	16,767,000	130,000	.....
San Bernardino	185	....	125	3.50	....	....	3 dy.	3 dy.	....	.....	22,000	.....	.....	.....
Long Beach	175	150	140	5 dy.	140	140	90	80	75	4.50	61,000	43,934,250	164,395	5,568,138

What Is the Future of Inland Water Transportation?—*Part I*

By Charles Whiting Baker
Consulting Editor, "Engineering News-Record"



There are here presented the results of a thorough study to determine the present economic position of inland water transportation, the field which it should occupy with relation to railway transport, and the consequent policy which should be adopted by the Government with reference to waterway development.

The investigation shows that traffic on nearly all inland waterways has all but disappeared. With few exceptions, the competition of waterways with railways is no longer of any consequence. The primary cause of the decline of the waterways is the extraordinarily low cost at which the railways of the United States are able to handle low-grade bulk freight, which is the only class of freight on which the waterways can hope to compete with railways.

The widespread belief in the great advantage of waterways, and the stock arguments in their favor, are fairly examined and are found to be based on conditions of the past, not those of the present.

The waterway was the only cheap means of transportaion before the railway came, and the invention of the steamboat multiplied the value of the waterway many times.

It was not until the railway had experienced a half century of development and the invention of the steel rail had made possible the use of heavy rolling stock that low-cost railway transport became possible.

In the battle between rail and water routes during the last quarter of the nineteenth century, public sympathy was strongly enlisted on the side of the waterway because it represented free competition as opposed to monopoly. The belief in the value of potential water competition to keep down railway rates has been almost universal. Government control of the railways has now demonstrated the fallacy of this belief.

The recent great increase in labor costs has hit the water carriers, notably coastwise steamers, much harder than the railways.

The success of water transport on the Great Lakes is shown to be due to conditions which cannot possibly be reproduced elsewhere.

I—Introduction—The Government's Policy Toward Inland Waterways

WHAT is the proper place of the navigable river and the canal in the country's transportation system? Can the steamboat and the barge compete with the railway train? If so, where and under what conditions? Should the United States continue to spend great sums improving rivers for navigation?

These questions are of pressing importance. There is on the one hand widespread belief among business men in the future of water transportation. The Chamber of Commerce of the United States adopted a waterway plank at its annual meeting in St. Louis in April, reading:

"We urge that the Government speedily complete river improvement projects already authorized, and that Congress provide for a comprehensive system of waterways with coördination of the services of waterways and railroads."

On the other hand, the public has become informed as to the practical failure of the Federal waterway improvement program. It is no secret that the annual river and harbor appropriation bill is commonly known as the "pork barrel" bill. Repeatedly on the floor of Congress has the wholesale waste in the Government's river and harbor work been exposed and condemned. Even the Presidential veto has at times been interposed, when the objectionable items in these bills became too scandalous.

The present is an opportune time to stop this waste. Drawing funds from the public treasury ostensibly for the improvement of navigation but really for flood protection, to benefit private interests, or to obtain the expenditure of Federal money in certain Congressional districts, is obtaining money under false pretenses. The nation can no longer afford, with the easy-going indifference of the past, to allow this waste to proceed unchecked. With a vast burden of war debt and huge continuing expenditures to remain long with us as a result of the war, rigid economy in national outlay is imperative.

The United States has spent many millions of dollars on inland rivers, and that, too, within recent years, where no navigation of any consequence now exists. It has built dams and locks on rivers where the only water traffic now is the floating of logs, and these went down stream more readily with the river in its original condition than with the navigation improvements. Surely it is time to stop such waste. Whatever sums the nation is to spend on waterway improvements should be concentrated on channels where the business will be sufficient to warrant the outlay. Scattering Federal money on all sorts of waterway projects, good, bad and indifferent, is an injury to the water transportation interests, not a benefit.

Government Lavish in Its Waterway Work

Waterway advocates have long asserted that the decadence of water transportation is due to the niggardly policy of the Federal Government regarding the inland waterways. How baseless is this assertion may be judged from the fact that the Federal Government has spent to the present time nearly a billion dollars[1] on river and harbor improvement, fully half of which has been devoted to inland waterways. In addition, over $300,000,000 has been spent by the states and by private corporations on inland canal construction. Most of these canals long ago became obsolete and were abandoned, though the one on which over half of the sum was spent, the New York Barge Canal, has only just been completed.

It may be supposed that the above-quoted figures for Government expenditures on waterways represent money spent many years ago, when inland water transportation was in its prime. The fact is, however, that fully half of all that the Federal Government has spent on river and harbor work has been spent within the past 15 years. Even on canals, the State of New York has spent within the past 15 years on its canal system two-thirds as much as all the outlay on all the canals in the United States previous to 1900.

In the face of this lavish expenditure on waterway improvement, inland water transportation has been steadily declining for many years. This is true not only of the smaller navigable streams but of the great rivers, including what was once the most important inland river transportation route in the United States, the Mississippi River.

The river steamboats on the Mississippi reached their climax of prosperity in the '70s. By 1890 the railways had shot so far ahead in the competition that St. Louis, the center of the river-borne commerce of the Mississippi valley, received 15 times as much freight by rail as by river steamboat. Statistics gathered by the St. Louis Merchants' Exchange show that in 1890 St. Louis received 663,730 tons of freight by river and shipped 601,862 tons. Sixteen years later, in 1906, the receipts at St. Louis by river had fallen to 327,670 tons and the shipments to 89,185 tons. During the same period the freight receipts by rail at St. Louis grew from 9,969,000 tons in 1890 to 27,292,000 tons in 1906. The rail shipments from St. Louis increased from 5,270,000 tons in 1890 to 17,672,000 tons in 1906.

Thus, while 30 years ago the receipts of freight by rail at St. Louis were 15 times as great as the receipts by river, a dozen years ago the river receipts had fallen to only 1% of the receipts by rail and the shipments by river were less than 0.50% of the shipments by rail.

There was, however, a widespread belief a dozen years ago that river transportation had reached its lowest ebb and that its revival might be confidently expected. Instead of that, the decline has continued. In 1918 St. Louis received 42,318,000 tons of freight by rail and only 60,450 tons by river. There were shipped out of the city 30,097,000 tons by the railways and 69,045 by the river. Thus, the steamboat commerce of St. Louis in the whole year of 1918 did not equal the railway commerce of half a day.

The few steamboats which still remain on the Mississippi and some of its tributaries are no longer competitors with the railways for through traffic. They are handling a small amount of local business only, on which the boat can for some special reason serve the shipper better than can the railway.

Meanwhile, the United States has gone on with its program of waterway improvement, and has spent money on inland rivers more lavishly during the past dozen years than ever before. The question whether the commerce which will use the improved channel will be sufficient to justify the expense is apparently a purely academic question in which no one in authority takes any interest. When a project is once officially adopted it is carried to completion even though the plans for it become obsolete during the preliminary stages.

The Hennepin Canal

A good illustration of the Government's conduct of its river and harbor work is the once famous Hennepin Canal in northern Illinois. This waterway was originally projected more than half a century ago as a short connection from the upper Illinois River to the Mississippi River. At that time river navigation was still a very active business in the central West. Waterways to compete with railways and cut down railway rates were being actively promoted. Elaborate computations were made to prove the great public benefit which the Hennepin Canal would confer in forcing the reduction of railway rates over a wide territory.

Very likely there was enough foundation for these

[1] The total of all Federal appropriations for river and harbor work, to July 18, 1918, was $971,142,916.

claims, at the time when the project was first agitated, to bring about the exertion of railway influence, then powerful at Washington, to delay action by Congress. At any rate, there was a long period of inaction before the project was formally undertaken. Once started, the work proceeded at the leisurely pace usual on Government works. The river steamboat business, for whose benefit the canal was undertaken, dwindled away, but no one in authority paid any attention to that.

After something like a score of years spent in construction, the canal was opened for business in 1907. It had cost the Government $7,566,000. There has been expended on it since, for maintenance and operation, $1,716,000. The total traffic on the canal for the past five years has averaged only 12,060 tons per annum. Here is a total investment by the Government approximating $10,000,000, plus over $90,000 a year paid out in operating expenses, all to accommodate as much business in an entire year as is carried in a single day over many of the railway lines in the same district. The fourteen locks on the canal must be continuously tended even though the solitude of the lock tenders may be disturbed only once a month by a passing boat.

And yet the case of the Hennepin Canal is not quite so bad as that of some of the other Government works for the benefit of river navigation. At the Hennepin Canal there is at least a lot of well-built masonry structures to serve as a monument for the $10,000,000 expended. There are rivers on which great sums have been spent by the United States, and nothing is left now to show for it. Floods have swept away all vestige of the work done; and the commerce which the work was undertaken to benefit has never materialized.

The public is familiar with charges of gross waste in the conduct of Government business; and the common idea is that the waste is due to dishonesty or inefficiency on the part of Government employees. But the above examples well illustrate the fact that *the chief source of waste in the public business is lack of intelligent planning.* The rank and file of Government employes can carry on routine work very well. They can build a Hennepin Canal when the work is ordered, and make a good job of it. What is lacking is someone with enough intelligence and authority to determine which works are worth while to undertake and which are not, and with the courage, when a mistake has been made, to stop the throwing of good money after bad.

If one inquires the reason why the blind expenditure on waterways has gone on so long almost unquestioned, an answer is found in the fallacious ideas which are so widely held regarding water transportation. A voluminous literature has been circulated for many years, devoted to the advocacy of water transportation. Much of it is the work of writers gifted with enthusiasm but ignorant of the foundation engineering and economic facts respecting modern transportation methods. Many of these writers have been employed to advocate a cause, not to deal with the subject from a professional and unprejudiced point of view.

Practically the whole of this voluminous advocacy of waterways, in books, pamphlets, newspapers and public meetings—and even engineering treatises—rests upon the assumption that water transportation is cheaper than railway transportation. The time has come for an unprejudiced inquiry as to whether this assumption is correct.

II—A Century of Transportation Development

For a clear understanding of the present relations of water and rail transport, nothing can better aid than a brief review of the past century of transportation development. The revolutionary changes in transportation during the past hundred years have transformed the world to a degree that we of the present generation, who have always been accustomed to the conditions created by steam power transport on land and sea, find difficulty in comprehending.

At the beginning of the nineteenth century the art of transportation was in the primitive conditions that had prevailed for ages. The sole power available for land transport was man or animal muscle. On the water this had long been supplemented by one of the great powers of nature, the wind. This was available only for the ocean and other open waters; but inland the rivers were and had been from earliest times the chief highways for freight transport. A horse or man could pull many times as heavy a load on a barge floating on the water as on a cart. Not only such rivers as are now called navigable, but any stream large enough to float a rowboat, was then a better means of freight transport than a road on land.

The Gallatin Report of 1808

The vital importance of economical transportation in advancing the public welfare was fully realized by the statesmen of a century ago. In 1808, Albert Gallatin, secretary of the treasury, made a report on roads and canals which is famous as embodying the first comprehensive plan for carrying out public works by the Federal Government. The Gallatin report made no mention of steam transportation, although an appendix contained a letter from Robert Fulton, who had made his successful voyage with the "Clermont" a year earlier. Gallatin proposed a chain of canals along the Atlantic coast to connect inland tidal waters. Canals across the Appalachian mountains to connect the Atlantic coast rivers with the rivers of the Ohio basin he concluded to be impracticable. Hence he advised that "artificial roads" should be built across these mountains to connect the navigable rivers on each side.

How small and primitive was the water transportation of that day may be realized from Gallatin's references to the few canals then completed. The James River Canal at Richmond could pass boats of eight tons drawing 3 ft. of water. The canals along the Mohawk River were 2½ ft. deep and passed boats of 10 tons. The greatest canal work in the United States was the Middlesex Canal in eastern Massachusetts, connecting the Merrimac river with the harbor of Boston. This canal could pass boats of 24 tons; "but those in most general use are of smaller dimensions and are drawn by two horses at a speed of three miles an hour."

Practically all the work then being done on rivers and canals and on turnpike construction was by incorporated companies, and the financial results were, almost without exception, disappointing. Gallatin recommended that the Federal Government should undertake the construction of canals and highways and the improvement of navigable rivers, covering all the territory embraced in his report. He estimated the total cost at only $20,000,000, and continued:

survival of the fittest, but was due to unfair competition.

"An annual appropriation of $2,000,000 would accomplish all these great objects in 10 years and may, without inconvenience, be supplied in time of peace by the existing revenues and resources of the United States."

Verily, those were the days of small things.

It is difficult to realize fully today what Fulton's invention meant to the world at the beginning of the nineteenth century. The railway was not yet born; good highways were almost unknown. There had never existed in the world such a thing as cheap inland transportation. The population of all civilized countries was therefore concentrated near the seacoast, where water transportation was available. It was impossible to fill with people the great fertile plains in the interior of the continents, such as the valley of the Mississippi, because of the lack of transportation. Although two centuries had passed since the first European colonies were established in what is now the United States, only the region along the Atlantic coast had been occupied.

Crude as were the first steamboats, they were so great an advance over any previous means of inland transport that they were put into use with marvelous rapidity. The rivers had always been the chief arteries of traffic, and now steam power could replace human muscle in the propulsion of boats. For more than twoscore years the steamboat was the prime factor in the development of the Middle West.

The Railway Era

The railway era began in 1825, when George Stephenson's famous locomotive, "Rocket," made its successful trial trip. The river steamboat and the canal boat were then well established. The same year that saw the birth of the railway witnessed also the completion of the Erie Canal by the State of New York. The importance of that waterway at that day in affording a cheap means of transportation between the central West, and the Atlantic coast, by connecting the Great Lakes and the Hudson River, it would be difficult to overestimate.

Stephenson's locomotive was built for high speed, not hauling power. Passenger and express business was the aim of the early railway promoters. They did not expect to compete with the river and canal for freight business; and the early railways were in fact too light and of too small capacity to move freight economically. These early railways were also very costly to construct and to operate. For the light traffic of the pioneer days, the river steamboat, operating on a road which nature had provided without cost, had no fear of railway competition. For the first three decades of the railway era, capital and labor were fully occupied in building railways in the thickly settled Atlantic coast states. The pioneering of the West had to wait.

Those were the halcyon days of the river steamboat. The Mississippi River and all its chief tributaries, where depth of water made navigation at all possible, were traversed by steamboats which were until the Civil War the chief and often the only means of transport. Not till a decade after the war did the decline of the Mississippi steamboat become evident.

In the Eastern states it was found at an early date that the railway had great advantages over the little artificial canals and over navigation on difficult rivers. The abandonment of the early Massachusetts canals followed closely on the coming of the railway. Year by year the railway became a more efficient means of transport; but its period of great development really began when the Bessemer steel rail began to displace the wrought-iron rail. The growth in size of cars and locomotives had been hitherto restricted by the rapid wear of the soft-iron rails. Bessemer's invention made possible that development of the railway as an economical freight carrier that has since taken place.

The Battle Between Rail and Water Routes

Before the coming of the steel rail, the battle between the railway and the steamboat had become active. Public sympathy, at first enthusiastic for the railway, had been enlisted on the side of the steamboat. Those pioneer railway lines were risky ventures, and the men who controlled them sought to make all the profits possible. They charged "what the traffic would bear," and few were prepared to deny their right to do so. The protest against this policy brought about the Granger agitation and legislation of the early '70s, which sought to establish just such control over railway transport and rates as was actually put in force half a century later.

At that time, few public men were bold enough to advocate direct Government control of railways. Sentiment was rather in favor of keeping alive competition, and especially competition by water routes. In 1872 a Senate committee headed by William Windom of Minnesota, who was later Secretary of the Treasury, made a remarkable report on transportation. After recommending legislation for Federal railway control on substantially the lines actually enacted in the first interstate commerce law 15 years later, the committee declared that "water routes when properly located not only afford the cheapest and best known means of transport for all heavy, bulky and cheap commodities, but they are also the natural competitors and most effective regulators of railway transportation."

The committee therefore recommended a system of water routes designed to carry the products of the Central West to the seaboard. Under the conditions then existing the recommendations were justified. At that time the average railway freight on a bushel of wheat from the Mississippi River to New York was 50c. A large part of the corn crop of the Middle West was not marketed because it could not stand the transportation charges. With the equipment and facilities and volume of traffic then prevailing, however, the railways in order to live were compelled to charge rates which today appear high.

Those were the days of sharp competition of railways with one another and of railways and water routes. Rates were made to meet competition as a matter of course. Where water lines were available, rail rates were reduced accordingly. No one questioned the railways' right to do this, any more than they questioned their right to meet the rate of a competing railway. So firmly was this fixed in the rate structure that in the interstate commerce act of 1887 the continuance of special rail rates to meet water competition was specifically authorized.

The period from 1875 to 1900 saw the rapid decline of inland water transportation, except on the Great Lakes. Waterway advocates assert that the driving out of the steamboat by the railway was not a case of the

The railway, even at that day, however, had great advantages over the waterway, apart from the question of relative rates. It is important to the shipper of freight that a carrier shall be responsible and shall give regular service. In its best days the river steamboat could not compete with rail service in these particulars. The water transportation line is subject to interruption by floods and by drought. The ice in winter in northern latitudes puts it out of business entirely during several months of the year. The risks of loss are many times as great as on goods sent by rail. These and other conditions, which will be more fully discussed later, greatly handicapped the water route in the competition.

The closing decade of the century was a period of great agitation among those who sought to maintain the position of water transportation. The idea of water-route competition benefiting the public had become firmly fixed. Congress undertook appropriations for waterway improvements on a larger scale than ever before.

President Roosevelt's Advocacy of Waterways

At the close of the century practically all of the old inland canals had either been abandoned or had lost all commercial importance, except the Erie Canal, owned by the State of New York. This was so dilapidated, and traffic on it was so rapidly declining, that it was clear that this canal also was rapidly becoming obsolete. This was the situation that confronted Theodore Roosevelt when he became Governor of New York after the Spanish War; and he appointed a commission to investigate and report what action the state should take.

The commission recommended the reconstruction of the Erie Canal as a large barge canal, at an estimated cost of $101,000,000. That work was undertaken and is now practically completed.

The interest in waterway development which Colonel Roosevelt acquired at that time was doubtless one factor which led him to devote such energy to the Panama Canal enterprise when he became President. He also became strongly impressed with the waterway propaganda then current, and lent the influence of his magnetic personality to furthering waterway development. In 1907 he appointed an Inland Waterways Commission "to prepare and report a comprehensive plan for the improvement and control of the river systems of the United States."

The commission was largely made up of men identified with the Roosevelt policies, and committed to a considerable extent to the current agitation in favor of water-transportation development. It was not to be expected that a commission so constituted and appointed with such instructions would bring in a report in any way antagonistic to waterways. The commission, however, in the face of the facts which were revealed by the investigations of its experts, could not lay out and recommend for adoption any such great system of inland waterways as was doubtless expected at its creation. Instead, it recommended the establishment of a permanent Government body to plan systematically for waterway development. The report also contained intimations that a considerable part of the waterways system existing and planned was of doubtful value—to put it mildly. One notable clause in the report read:

"We recommend that any plans for improving the inland waterways shall take account of the present and prospective relation of rail lines to such waterways and shall ascertain, so far as may be, whether such waterways when improved will be effectively used in the face of railway competition."[2]

At the time when this report was rendered Congress and the President were at loggerheads. The report of the commission, which was appointed by the President without authority from Congress and which had no appropriation to pay for its work, had little influence with the legislators at the capital, and no action was taken on the Inland Waterway Commission's recommendations.

The only attempt which the Government has ever made, therefore, to investigate the water transportation situation (and even this was not a broad, unprejudiced investigation) has had little or no influence on its action. The Government has since pursued its work of waterway development as it always has done, without any systematic plan or policy. A waterway commission provided in the rivers and harbors bill of 1917 was never appointed by President Wilson.

The Organized Promotion of Waterway Projects

The chief influence which has controlled the Federal appropriations for waterways is the organized propaganda in favor of such appropriations which has been carried on in wholesale fashion for many years. This propaganda has been successful in creating a widespread public opinion in favor of waterways. The public, and especially the commercial interests, implicitly believe that the waterway is inherently a cheaper means of transport than the railway, and that the provision of a waterway at Federal expense will therefore benefit the adjacent shippers and communities. Commercial organizations, therefore, can usually be officially enlisted in favor of waterway appropriations. Others active in promoting waterways are those interested in steamboat lines and in contracts for work on waterways. Still more influential are the interests which seek to have the Federal Government improve rivers ostensibly for navigation, but actually for flood protection.

With this pressure behind Congress, it is entirely natural that appropriations for waterways have been liberal. The individual Congressman has no means of sifting the claims made by the waterway promoters, and he has not the technical knowledge needed to uncover fallacies in the arguments presented. Very little attempt has been made to expose these fallacies. Arguments against waterway appropriation have been generally combated by the waterway promoters with the charge that the objector was "working for the railway interests."

There has thus grown up in the public mind the belief that advocacy of waterways and defence of water transportation are closely related to advocacy of public interests instead of private interests; of free competition in transportation rather than monopoly; of conservation and utilization of natural resources for the public benefit.

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[2] A report on transportation by water in the United States was made by the Commissioner of Corporations at about the same time as the Inland Waterways Commission's report. This report was largely inspired by the theory that the cause of the decline of water transportation was the lack of proper terminals for freight handling, and especially the control of water terminals by railways. Neither of these investigations, therefore, was undertaken as a broad, unprejudiced study of the water-transport situation; and it is easy to detect in the reports the personal views of individual members. Nevertheless, these reports and the studies by expert investigators which accompanied them are the most nearly complete and valuable record of water-transport conditions in the United States that has ever been made.

This is so well recognized that a necessary plank in most political platforms for many years has been a declaration in favor of waterways. The candidate for public office feels sure of approval when he throws into his speeches a few ringing sentences urging improvement of the waterways and condemning the railways. It would be useless for him to pursue any other course. Were he to voice a doubt as to the soundness of the lavish expenditure on waterways, he would be assailed on every hand with quotations from many supposed authorities, all proving him in the wrong, and grave doubts of his sincerity and honesty would be at once aroused.

III—Changes During the Past Twelve Years

When the Inland Waterways Commission made its investigation a dozen years ago, it was taken for granted that the inland waterways ought to be improved and put into use. There were at that time enough of the old-time river steamboats still running on Western rivers to encourage the belief that inland water navigation might be revived and again become important. The cry had long been, Let the Government improve the channels, and the commerce will follow. The channel improvements had made great progress, and speedy results were looked for.

These results have not materialized. Instead of a revival of water transportation, there has been a continuous decline. The great expenditure of the Government on channel improvement has had, broadly speaking, no results. On the improvement of the Mississippi River below Rock Island, Ill., the Government has spent about $100,000,000, though, to be sure, a large part of this went into flood protection. The Mississippi is deeper, and better for navigation, than the Rhine, Europe's greatest interior waterway. Yet the Mississippi has been practically deserted by through traffic. On that river and most of its tributaries, on many of which the Government is still building and maintaining costly works for channel improvement, the few boats which remain are carrying local business only.

The official statistics giving the tonnage of waterborne commerce on inland rivers are misleading, because many inland rivers are still extensively used for floating logs and timber, and also because of the great increase in the use of rivers as a source of sand and gravel. To credit the Government's channel improvement works with the tonnage of logs floated downstream and with the tons of sand and gravel dredged from some nearby bar and towed a mile or two to a convenient site for unloading, is absurd. In most cases the sand and gravel would have been as easily obtained and the logs would be as readily floated with the river in its natural condition.

The various "projects" under which improvements of inland rivers are now being prosecuted were adopted in most cases many years ago. Many projects had their first inception during the '80s or '90s, when the country had just become aroused to the fact that the river steamboat was yielding to railway competition, and when the public demand was urgent that the waterways should be improved to hold their own with the railways. Where projects have been revamped it is generally with the idea of reconstruction on a larger scale. Very seldom has the question been squarely faced whether the time had not passed when the channel could be profitably used for navigation.

Probably the most powerful influence back of the campaign for Federal expenditure on waterways has been that of the property owners in the Mississippi valley. One of the most valuable public improvements of the last half century is the reclamation of the fertile lands along the Lower Mississippi River by the construction of levees and bank revetments, to protect the land from floods and make permanent the channel of the river. A large part of the money for this work has been supplied by the Federal Government; but its expenditure has been made ostensibly for the improvement of navigation. Three years ago a new precedent was established, and Congress made a direct appropriation for flood prevention on the lower Mississippi River. Thus one of the chief sources from which the propaganda in support of river appropriations has been financed has now been removed, and there is that much better chance of having the case of the waterways considered fairly on its merits.

No change during the past dozen years has been of greater importance in its bearing on the waterway question than the altered situation of the railways.

From the time when competition of the railway with the steamboat first became evident, the argument has been potent that waterways were a public necessity to keep down railway rates. That argument had its birth in the days when belief in railway competition as a necessary protection to the public was still almost universal. Better even than railway competition, it was held, was water competition, because steamboat lines could not be combined and controlled like competing railway lines.

Good Results From Government Railway Control

Of course, this argument for waterways became invalid when the Government established its direct control over railway rates. There still remained, however, a widespread belief in the value of water competition. Not until the recent transfer of the railways to Government control and operation has the public been able to view this matter in its true light.

It is now clear to everyone that the railways must have rates high enough to live on and continue operation; and not only that, but enable them to expand and develop to meet the country's necessities. If rates are insufficient for this, the deficit will have to be made up from the public treasury with money raised by taxation, as is actually being done today. If the dream of some of the waterway promoters were realized and "a comprehensive system of waterways" were constructed, and if that system operated to reduce railway rates, the deficit to be made up by the taxpayers would be that much larger.

One finds repeatedly in waterway literature the argument that waterways would be justified even if they were wholly unused, merely because of their influence in reducing railway rates. The present situation of the railways shows the absurdity of this reasoning. If the waterways were able to divert from the railways a large amount of business which the railways could handle at a profit, the deficit for the taxpayer to shoulder would be even greater.

Thus the great experiment of Government railway control, undertaken for the war emergency, has been a most valuable demonstration that the railway, as an

absolute public necessity, must have rates high enough to enable it to live, and that any water transport line must be justified by what it can accomplish as an economic carrier. As a mere competitor of the railway it will be an injury and not a benefit to the public.

Government operation of the railways has also made it far easier to demonstrate to the public that unnecessary duplication of transportation lines is a waste and not a benefit. To build two railways where only one is needed, or both a railway and a waterway where the railway alone is sufficient, is a waste of capital and labor which results in a perpetual burden on the public. The waterway, to be economically justified, must be shown to be needed by the public in addition to the railway facilities, and must be needed to an extent that will bring traffic to it sufficient to yield a fair return on the cost.

Waterways To Relieve Railway Congestion

One of the arguments for water transportation which has been oftenest repeated is that waterways are needed to supplement railway facilities at times of railway congestion, so that the public need not lack for transportation at such times.

It is doubtful whether the many eminent men who have put forward this argument ever gave it enough serious study to find out what it would involve in its practical application. Since the argument has been put forward by various high authorities, it may be appropriate in this place to inquire what would be involved if waterways were built and used merely to carry the railway "peak loads."

Under normal business conditions, the railways of the country are capable of carrying all the business offered. At certain intervals, however, business expands more rapidly than railway facilities, and congestion of traffic and car shortage prevail. In 1906 and 1907 the greatest car shortage ever known in the United States occurred. In February, 1907, the demand for cars by shippers was 125,000 in excess of the supply. It was at exactly this time that the agitation for Government expenditure on waterways was most aggressive. Doubtless, many thousands of business men considered it fully demonstrated then that "a comprehensive system of waterways" was urgently needed to carry the traffic which the railways were unable to handle.

Near the close of 1907 came a business panic. The car shortage promptly disappeared, and a huge car surplus took its place. In 1908 and 1909 the railways of the United States had an average of over 100,000 idle cars. Companies which were hard pressed financially had to build many miles of new track on which to store their idle cars. Not for eight years—until 1916, when the war business came on—did the country again experience congestion of railway traffic and car shortage.

After the armistice was signed, railway traffic fell off materially, so that whereas in 1918 various railway companies were struggling to get each its share of the new cars which the Federal Railroad Administration was building, by the spring of 1919 the different companies were politely waiving their claims, and each was urging that some other road certainly ought to have its need for cars supplied first!

Suppose now it were seriously proposed to provide waterways, boats and terminals to carry traffic at such times only as the railways were unable to handle it. Merely to state such a proposition is to demonstrate its absurdity. Who would pay for boats to be used only a few months at a time, once in half a dozen years or so? No business concern would do it—and if it did its losses would soon put it out of business. The Government treasury might be called on to stand such a loss; but a transportation business which operated only in a rare emergency would certainly prove inadequate and inefficient when the emergency came. This is not a mere theory; it has just been proved by actual experience. During the memorable railway blockade of 1917-'18 the inland waterways were available, and a considerable number of old boats were obtainable for use on them, but the organization to use the waterways effectively was lacking, and consequently the waterways remained unused when transportation was in more urgent demand than ever before.

The absolute impotence of the waterways to supplement the railways at that crucial time is best shown by figures: The total river traffic of St. Louis was 151,590 tons in 1916; it was 150,380 tons in 1917, and in 1918, when railway congestion was most acute, it was 129,495 tons. In contrast with this, the railway traffic of St. Louis was 76,126,000 tons in 1917, and 72,354,000 tons in 1918. These figures show not only that river traffic actually declined during the year of greatest railway congestion ever known, but that the volume of railway business is so enormous that if the waterway were to be a really valuable supplement to the railway in times of traffic congestion it would have to be equipped with boats and terminals on a huge scale.

It will not escape notice, too, that only in a very few locations are waterways available to supplement railways, and that the worst railway congestion ever known in 1917-18 was during the winter months when the waterways were closed by ice anyway. Sufficient has been said, however, to show how chimerical is the proposition to use the waterways to relieve railway congestion.

Relative Capacity of Railways and Waterways

An argument closely akin to the one just dissected is the argument that waterways are needed to supplement the railways because of the great capacity of the waterways. It is known that a large amount of new capital must be invested in the country's railway system to enable it to expand to meet the growth of traffic, and it is urged that this increase in the country's transportation facilities should be made in the water transport lines rather than in the railways, on the ground that a given expenditure of capital in waterways would produce a greater additional capacity.

The facts and figures to substantiate such a claim, however, are lacking. The common idea that a waterway on a natural river costs substantially nothing to make and to maintain is fallacious. On the contrary, the few inland waterways of the United States, where there is any chance for a revival of traffic have cost as much per mile to improve as the cost of building a first-class railway.

Besides this, the traffic capacity of a railway is almost without exception fixed by the capacity of its terminals. The work on expansion of the railway system during the past decade has been almost all

devoted to terminal enlargement and improvement, or else to extensions and branch lines in districts far inland, removed from navigable waterways. One can hardly identify a single piece of railway construction carried out during the past decade which would have been less necessary by reason of any practicable expansion of waterways.

The capacity of the waterway, like that of the railway, is fixed by the capacity of its terminals. In all the estimates of the capacity of water routes which have been made, one will look in vain for estimates of the cost of terminals commodious enough to care for a volume of traffic equal to the estimated capacity of the waterway.

Building Boats for Inland Waterways

Nothing is more illuminating as to the present condition and future prospects of inland water transportation than the condition of the boat building industry. If there are conditions which make probable an early revival of transportation on inland waters, those engaged in building craft for use there should be the first to foresee and prepare for such a revival.

The United States Census Bureau has just issued a bulletin giving statistics of shipbuilding for the entire United States, and containing figures for the industry for the years 1916 and 1914. The accompanying table gives the figures of most interest for the year 1916:

SHIPBUILDING IN 1916 ON INLAND WATERS

	Great Lakes	Mississippi River and tributaries	All Other Inland Waters
Number of concerns	131	101	97
Persons engaged	9,567	2,419	679
Capital employed	$36,024,371	$4,570,879	$1,368,762
Value of products	22,094,456	5,034,674	1,361,470
Value of work on new vessels	13,101,506	1,560,037	66,184
Value of repairs on vessels	6,465,800	1,063,853	256,549
Value of all other products	2,051,126	2,082,829	194,326
VESSELS LAUNCHED DURING 1916			
Number	89	234	9
Gross tonnage	121,234	50,593	925
Steam Vessels:			
Number	46	20	.....
Gross tonnage	102,464	3,618	.....
Barges:			
Number	13	190	5
Gross tonnage	4,100	46,426	880

It will be seen from this table that the building of boats for use on the Mississippi and all its tributaries is a business only one-ninth as large as shipbuilding on the Great Lakes. It employs about $4,500,000 capital and fewer than 2500 workmen. It is carried on by small concerns with an average capital less than $50,000 and employing fewer than 25 men. These concerns built in 1916 only 20 steamboats averaging 180 tons in size. They were occupied chiefly with repair work and the building of barges. The average size of the barges built was only about 250 tons.

It may be thought that the showing for 1916 represents a paralysis of business due to the war. Comparison with the figures for 1914 shows that, on the contrary, the war conditions stimulated the business considerably. The business of 1916 was more than double that of 1914.

In studying these figures, it must be remembered that the Mississippi and its navigable tributaries have an extent of several thousand miles, and there is in the aggregate a considerable amount of local business on these rivers, where small craft serve river communities which may not be reached by a railway. The building of boats for this purpose, and the building of boats to maintain the great fleet of vessels which the Government keeps busy on channel improvement works, are sufficient to account for the amount of boat building which is shown in these census statistics.

The Effect of Changes in Labor Costs

Few are aware of the revolutionary change in the conditions of water transportation which has been brought about by the enormous increase in the cost of labor. The increase has, of course, had serious effect on the railways and is, indeed, chiefly responsible for the present great deficit in railway net earnings. The water transport lines have been hit still harder; for the steamboat on inland waterways, being of relatively small tonnage, requires a much larger labor force to produce a thousand ton-miles of transportation than does the railway.

Those who hope to see the old-time steamboats come back to the Mississippi and other Western rivers have only to consider the cost of operating those boats at the present wage scale to see how baseless is such a hope. It was necessary for the steamboat which plied up and down the river, making frequent stops, to carry besides her regular crew of engineers and stokers a swarm of deck-hands to hustle freight on and off the boat at the landings, and bring cordwood on board for use under the boilers.

Today the wages of a deck-hand are at least four or five times what they were forty years ago, and the crew's wages are proportionately raised. No boat can afford to carry a crew large enough to handle freight on and off at landings in the old way; especially is this the case if boats are to be used for other than local traffic and to make long runs, as from New Orleans to Memphis or St. Louis.

It is only on these long runs, however, that the boat can have any chance of competing with the railway. On short hauls the difference in cost by rail and by boat will be too small to be controlling, and the shipper will send by whichever route offers best service in other respects.

Lack of Stevedores at River Ports

But on the long-distance voyage, what will the steamboat operator do about handling cargo? It takes ten days to a month for the voyage between New Orleans and St. Louis. It would be absurd to pay the wages and board during the voyage of sufficient deck-hands to handle the cargo at the terminals. The river boat, therefore, must now, like the ocean vessel, rely on local stevedore labor to load and unload her freight.

At New Orleans, as at any other great seaport, stevedoring is an organized business, and there is comparatively little difficulty in getting the cargo handled with reasonable promptness and moderate expense; but this is not the case at St. Louis or at any other city on an inland river. The volume of river steamboat business has for years been too small and too irregular to support any reliable stevedoring concerns. The river steamboat operator, therefore, must use such floating labor as he may be able to pick up to do the work of taking on and discharging cargo at a river port. Such labor is very inefficient and

expensive. This condition is bound to continue, no matter how much money or how intelligent design may be expended on terminal facilities on inland rivers, until river transportation becomes a large business.

Again, the movement of vessels in river traffic is subject inevitably to great variation, so that the time of arrival of a boat at a port is uncertain. In order to keep stevedores on hand to be available when wanted, a great deal of idle time must be paid for. Even then, a boat will be subject to considerable delays in port waiting for a gang to handle her goods. This is true even of ocean transportation. In times when business is active and labor scarce, as was the case during the war, it is not uncommon for ocean vessels to be detained for days awaiting stevedores to handle the cargo.

High Labor Costs Hurt Coast Steamer Lines

Probably few are aware how severely the great advance in wages has hit the coastwise steamer lines. The ocean vessels were able to meet the wage increase by an even greater proportional increase in their cargo rates; but the coastwise vessels can obtain business only by maintaining rates below those of the railways, and the railway freight rates were raised only 25 per cent. The result has been to lower earnings in many cases below operating expenses. The Clyde Steamship Line in February, 1919, abandoned operation of its line from New York to Mobile and Tampa, which it had operated for 16 years, its line to Wilmington and Georgetown, in operation for 30 years, and its Philadelphia and Norfolk line, with a record of 50 years. On June 7 its line between New York and Philadelphia was also discontinued.

The longshoremen's strike, which tied up the port of New York for more than a month in October and November, 1919, was precipitated in part by the attempt of the Federal Wage Adjustment Board to fix a lower rate for handling cargo for coast vessels than for ocean vessels. The board publicly announced as its reason that the coast lines were operating on so narrow a margin that to grant the increase the longshoremen asked for, and which the board held was justified by the increased cost of living, would put some of the coast lines out of business.

Here are water routes with all the advantages of the deep water of the ocean and with long-established terminals for the economical handling of traffic, abandoned or on the point of abandonment because of inability to pay expenses in competition with the railway lines. If such water routes are unprofitable, it is surely worth inquiry whether the long-accepted idea that inland water transport in artificial channels is cheaper than rail transport holds good under present-day conditions.

IV—Transportation on the Great Lakes

There is one inland waterway in the United States on which traffic has increased at an enormous rate; and which has fully justified all the expenditure which the Federal Government has made on its improvement. This is the waterway through the Great Lakes.

Before the railway or the steamboat came, these great inland seas were the chief means of reaching the interior of the continent. Most of the early settlers of the region bordering the lakes emigrated by this route. The application of steam to navigation and the opening of the Erie Canal greatly stimulated the flow of population to this region, and the current of east and west traffic on the lakes assumed large proportion.

It was not till after the middle of the century that the railways between the Eastern seaboard and the Central West were developed to a point where they could compete at all efficiently with the lake vessels, and then their competition was only for merchandise freight. The bulk freight which forms the largest item in tonnage statistics could be carried so much more cheaply by the lake vessels that the combined lake and rail route was still the cheaper for through traffic, notwithstanding the cost of transferring freight from the cars to the boats at Chicago and back to the cars again at Buffalo.

Freight-Transferring Machinery

As the cost of rail transport was steadily reduced, lake transportation would have fallen off as river transport did, except that the cost of transferring bulk freights on the lakes was also reduced. Nowhere else in the world has machinery effected such marvelous reductions in the cost of transferring bulk freights between the railway car and the ship as on the Great Lakes. Nowhere else in the world does there exist so huge a volume of traffic in bulk freights as flows between the ports at the head of Lake Superior and those on the lower lakes. It is this huge volume of business, indeed, which has made possible the great investment in labor-saving machinery at the terminals.

About three-fourths of the traffic on the lakes is in iron ore and coal, transported in vessels of much larger capacity than the average ocean freight steamer. These vessels take on their load of ore at the head of the lakes from huge bins which discharge their contents into the hold by gravity. Only a few hours' stay in port are necessary before the vessel is ready to start on her return voyage. At the lower lake port the ore is removed from the hold by enormous automatic grab-buckets. Coal for the return trip is loaded on the boats by machines which pick up a full-size railway car, invert it and pour its burden of 50 to 70 tons of coal into a chute that discharges into the vessel's hold.

This machinery so greatly reduces the cost and the time necessary for the transfer between the railway car and the vessel that such a double transfer becomes possible without absorbing the saving made by the lower cost of the movement by vessel compared with the movement by rail.

To a considerably less extent, the same thing is true of the handling of wheat and other grains. The cost of transfer here, however, is much greater, and the net saving by the water route plus the transfer cost is not enough to prevent a large movement of grain to the seaboard by all-rail routes.

Lake Navigation Is Unique

The lake traffic is unlike any other inland water transportation. The vessels which carry it must be able to stand waves and storms only less severe than those of the ocean. They are deep draft vessels; not as deep, indeed, as the large ocean freighters, because the principal lake harbors permit a draft of only 21 ft., but substantially like ocean steamers and entirely

unlike the broad, shallow-draft vessels used on other inland waterways.

The lake ore and coal freighters carry traffic at a ton-mile cost as low as that of ocean steamers, notwithstanding the handicap they are under of a comparatively short voyage and of idleness during five months of the year when ice blocks navigation. They are able to do this because of the machinery for rapidly loading and discharging the vessels which reduces the necessary time in port to a few hours and reduces to a very low figure the terminal expenses per ton carried.

It is important to understand clearly the lake traffic conditions, because one of the stock arguments of waterway advocates has long been the great volume of traffic and low rates on the Great Lakes. It seems almost needless to say that the conditions on the lakes cannot be duplicated on any inland river. Not the depth, the volume of possible traffic, or the huge expenditures on terminal machinery exist on any other inland water route; yet time and again the Great Lakes conditions are cited by waterway enthusiasts as illustrations of what might be done were "a comprehensive system of waterways" available.

A great amount of time and money has been expended in promoting various schemes for "deep waterways," on the assumption that because water transport is cheap on the deep water of the ocean and the lakes, goods could be carried at similar low cost on artificial deep-water channels.

The fallacy of this idea is made plain by the following quotation from the report of the Commissioner of Corporations on transportation by water, issued in 1909:

> The expense of securing channels of sufficient depth in rivers and canals for ocean or the larger Great Lakes steamers would, except in a few cases, be prohibitive if at all possible. If a sufficient depth were secured, other conditions would prevent their use by oceangoing vessels to any appreciable extent. . . . The important question to be determined is the relation between the cost of improving waterways and terminals and the reduction in transportation charges made possible by such improvements. This involves careful engineering study of the cost of improvements and the cost of transportation on waterways of different kinds.

Again, the great reduction in the cost of handling freight at the lake ports is made an argument for similar facilities elsewhere. But the great investment in ore bins and automatic shovels and car dumps at the lake ports is only warranted because of the volume of bulk freight traffic handled. Such low cost of handling has never been approached in the handling of merchandise freight at terminals. At these very lake ports there are few facilities for the economical handling of merchandise freight.

These are some of the reasons why the experience on the Great Lakes is not a safe guide for dealing with other inland water routes.

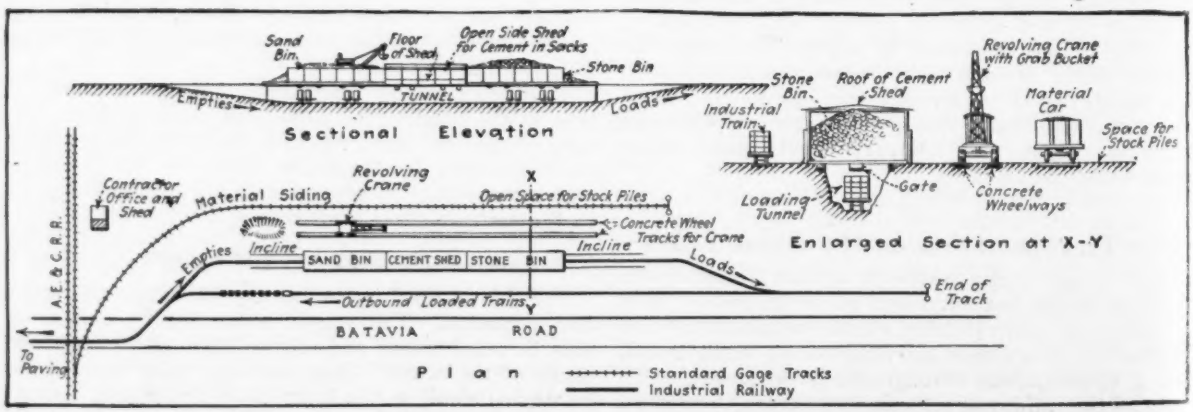
(To be continued)

Concrete Road Contract Has Plant for Rapid Progress

Batch Boxes Loaded in Tunnel Hauled on Industrial Railway With 5 Per Cent Grade to Large Mixer—Material Yard at Railway Crossing—Nine-Mile Contract

A TUNNEL system for loading batch boxes, a revolving crane traveling on concrete wheelways, a concrete mixer of high capacity, and large machinery equipment, are features of a construction outfit that has made a concreting record of a foot a minute on a nine-mile stretch of the Lincoln Highway near Wheaton, Ill. This record has been made only intermittently, owing to conditions of the material market and of transportation which make it impossible to maintain a full supply, while a 5% grade between the material yard and the mixer also causes some interruption of supply to the mixer.

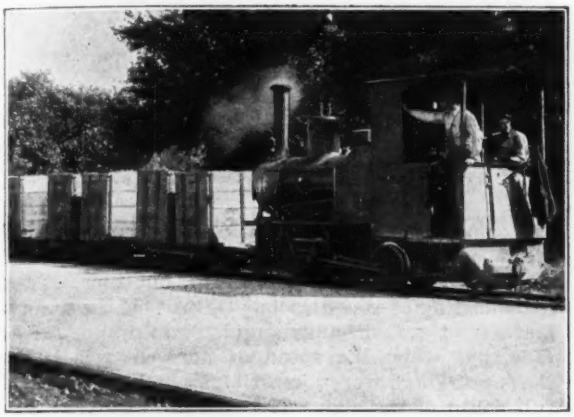
The layout of the material yard is shown in the accompanying drawing. This yard is located about midway on the stretch of road, at the intersection of the Aurora, Elgin & Chicago Electric Ry., a spur from which is laid into the yard. Most of the cars are delivered in this way, and a recent railway strike lasting some weeks caused serious delay to the work. Some cars were shipped over the Chicago & Northwestern Ry. to Wheaton, the materials being then hauled to the yard in wagons, but this supply could not meet the requirements of continuous, rapid work. Slow and irregular deliveries have been a constant



LAYOUT OF MATERIAL YARD FOR NINE-MILE CONCRETE ROAD—BATCH BOXES ARE CHARGED IN TUNNEL FROM BINS LOADED BY ROAD CRANE

trouble, so that progress is governed largely by conditions beyond the control of the contractor or his superintendent.

Batch boxes carried on the flat-cars of an industrial railway are employed for hauling material to the mixer. These are run under bins in the usual way, but instead of elevating the bins they are placed upon the ground over a tunnel or subway in which the track is laid. The sand and stone bins have the bottoms formed of transverse timbers (old car sills) laid close together, each bin having four loading gates. Between the two bins is a covered platform for the cement, having canvas side curtains for use when the

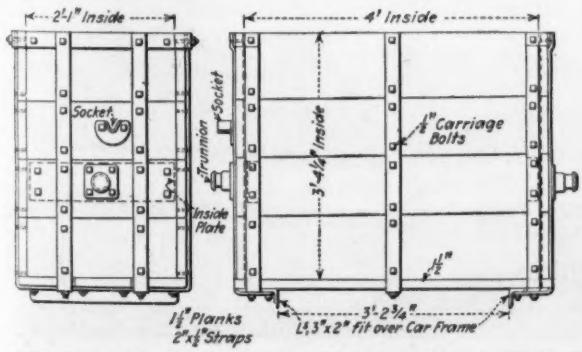


TRAINS OF CARS CARRYING BATCH BOXES SERVE CONCRETE MIXER ON ROAD WORK

plant is not working. In the floor of this platform are four wooden chutes, through which the cement is poured from the sacks by hand.

Bulk cement was tried at first, being stored in a bin with bottom gates. No measuring hopper was used and it was found impracticable to handle the direct flow. At times the cement would flow steadily like sand, but at other times it would come down like water, overloading the box and spilling out into the tunnel before it could be stopped. To install measuring hoppers, the bin must have been raised or the tunnel track lowered, but after some changes and experiments this plan was abandoned in favor of the method adopted.

The batch boxes are of the tilting type, as shown in one of the drawings, the contractor preferring these to drop-bottom boxes. They are built of 1½-in. plank and iron straps put together with ½-in. carriage



BATCH BOXES TILT BY GRAVITY ON TRUNNION SUPPORTS

bolts. The inside dimensions are 48 x 25 in., and the boxes are 40¼ in. deep; the capacity is about 28 cu.ft. This was the first job on which these knockdown batch boxes were used. The iron parts were furnished by the Koppel Industrial Car & Equipment Co., being shipped in bundles to the job, where the contractor supplied the wood and did the assembling. There are trunnions on the ends, placed below the center of gravity so that the box will tilt readily. One end also has a catch or socket for a pin in the handling bail used at the mixer, this pin preventing the box from tilting prematurely.

Two boxes are placed on each car. The empties are fed into the tunnel by gravity under control of brakes, a number of the cars having hand brakes. Two men in the tunnel place the cars under the gates of the sand bin and fill the boxes to a gage mark. They then shift the cars to the cement chutes for a four-sack charge, then on to the stone or gravel bin, and finally to the mouth of the tunnel.

A revolving crane on wide-tired road wheels and carrying a ¾-yd. grab bucket travels on a roadway between the bins and the railway siding, this roadway having concrete wheelways to give a good track for the crane in all weather. These wheelways are 6 in. thick and 24 in. wide and are 4 ft. apart, but as they were put in service too soon the concrete cracked badly and timber sills have been laid upon them. This crane unloads the cars and places the materials either in the bins or in stock piles from which they are rehandled as required. It is found that the crane can unload cement in sacks more rapidly than in bulk. A sack carload equivalent to 250 bbl. can be unloaded by two men in about four hours, as against five to six tons for an equal quantity of cement in bulk. As many as 18 sacks are handled by the bucket at one load. A slight grade on the siding enables the material cars to be moved along by means of pinch bars.

Portable track sections are used for the 24-in. industrial railway, these sections being 15 ft. long, with 20-lb. rails bolted to steel ties and having fishplate joints with four bolts. The track is laid along the side of the roadbed, outside the line of the forms, except that where the concrete road has been completed for some time the track is shifted upon it, being ballasted lightly with earth. Elsewhere the ballast is mainly stone obtained in dressing the old macadam surface.

Two grade crossings occur on this industrial railway, as shown by the plan. At the spur into the material yard the industrial line is at such a level that a 15-ft. section of track can be laid across the rails of the spur, being removed when this line is not in service or when cars are to be moved on the spur. At the crossing of the double-track main line, the industrial track is embedded in concrete, flush with the tops of the rails. This concrete is laid close against the outer side of the 20-lb. rails, while on the inside it is laid between angle guard rails which form the flangeway for the narrow-gage equipment.

Two 7-ton locomotives and a number of cars and batch boxes constitute the transportation equipment serving the mixer. Practically all trains are pushed by the engines. The schedule provides for the leaving of trains from the material yard at 30-min. intervals. Each engine can take 12 cars (with 24 batches) on

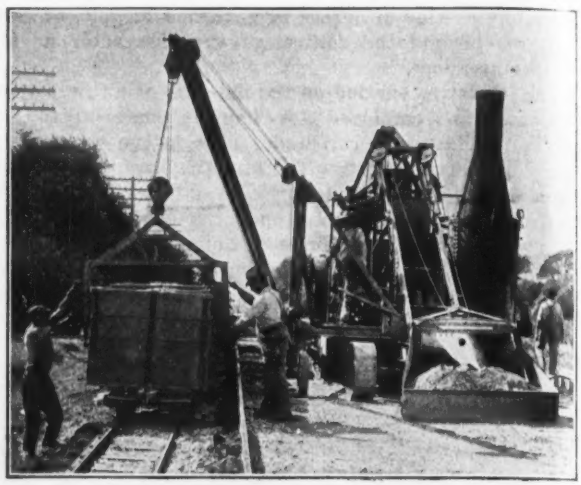
fairly level ground, but the heavy grades in this case limit the trains to eight cars, as a rule. In regular working, the first engine pulls a train from the tunnel and then pushes it over the running track as far as the foot of the 5% grade, where it puts four cars on a stub siding and so doubles the train over the grade to a turnout on the level. This is about a mile from the yard. The second engine, which has placed a train of empties on the turnout, pushes the loaded train on to the mixer, while the first engine goes into the turnout and pushes the empty train back to the yard.

At the mixer the cars are handled by three men, who place them in position for the derrick and then run them into a siding. Two of these men attach the boxes to the hoisting cable, swing them over to the charging skip, dump them and return them to the cars.

A mixer of 21-ft. capacity is used, and can deliver concrete sufficient for an advance of 1 ft. per minute for an 18-ft. slab of 8-in. concrete. It is estimated that the mixer is capable of making an advance of 500 ft. per day, but under the conditions noted the maximum so far has been about 300 ft. In two consecutive runs the 16 batches of each train were handled in 26 min. and 31 min. from the time the first batch box was lifted off the car until the last batch was dumped on the roadbed. A 1: 2: 3½ dry mixer of jelly-like consistency is produced which meets the slump test, using ordinarily 15 gal. of water per batch, but at times the concrete is fairly wet. Water is supplied by a pipe line laid along the road and connected to a city hydrant.

Attached to one forward corner of the mixer frame is a derrick mounted on a two-wheeled truck and with the hoisting line led to a drum on the mixer. This line carries an iron bail, the vertical sides of which end in loops to engage the trunnions of the batch boxes, while a pin thrust through a hole in one side of the bail engages the socket on the box, so that it cannot overturn while being swung. A bottom-discharge bucket places the concrete, this bucket traveling on a horizontal boom.

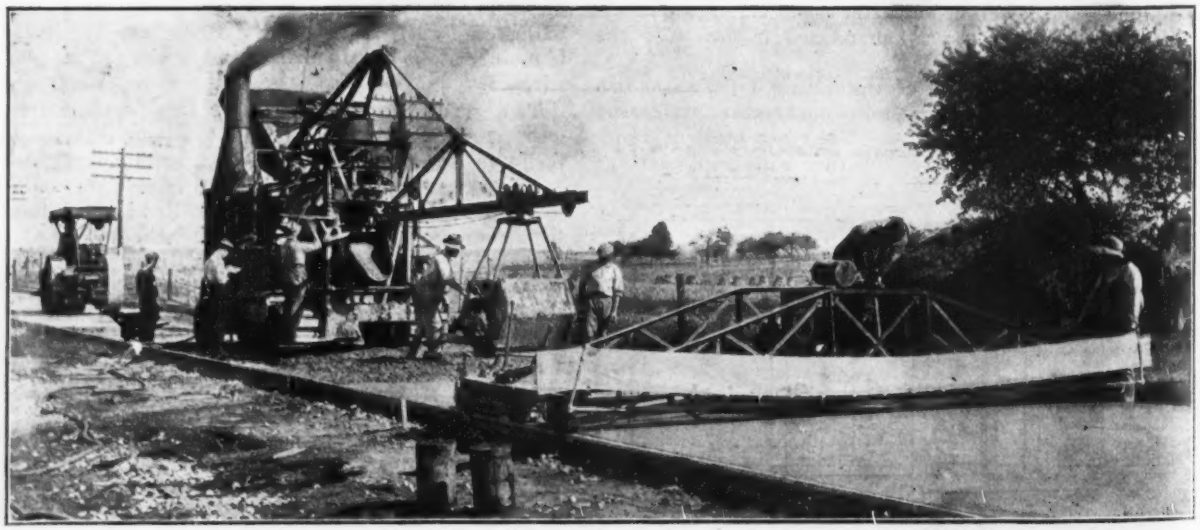
As soon as the concrete is spaded between the steel forms, a mechanical tamper is run over it, but usually



CONCRETE ROAD WORK WITH TILTING BATCH BOXES SWUNG FROM CAR TO CHARGING SKIP BY A PONY DERRICK

the concrete is so deep that it piles up against the strikeboard and the men have to spade it away. The same machine gives a belt finish, but there is some hand floating of rough spots. On part of the work, the belt gave the familiar triangular marking of the surface, but when the speed of advance was reduced these markings were almost straight lines across the full width of the slab. The edges are finished in the usual way.

Canvas covers are laid directly upon the concrete when it has set, to protect it from the drying action of sun and wind, these covers being kept wet. Both earth cover and ponding are being used for curing, but here another trouble has been experienced in occasional interruption of the water supply, which is piped from city hydrants through metered connections. No expansion joints are used, the only joints being those at the ends of each day's work. Transverse cracks have already appeared, and will be filled with tar, this filling being a final treatment of the road. Graders will be used to remove the earth cover,



TAMPING MACHINE WITH FINISHING BELT FOLLOWS MIXER CLOSELY

and graders or scrapers will build up the shoulders after the concreting has been completed.

Some heavy grading is required to lower old summits, but in the main the surface is a road of water-bound macadam laid only a few years ago. Large graders and scarifiers are used to level the surface to grade, the machines being hauled by powerful gasoline tractors. After the forms are placed the roadbed surface between them is dressed to a templet by hand and is then finished with a heavy steam roller.

The concreting gang consists of ten men with a timekeeper, distributed as follows: Three men handling batch boxes and cars; one operating hoists of derrick and charging skip; one firemen; one mixer operator; two spreading concrete; one operating tamping and belting machine; one floating rough spots and dressing the edges.

This work is being done on a joint contract by J. A. Ross and the Calumet Concrete Construction Co., Chicago, with Eben C. Chase as superintendent. It is under the direction of George N. Lamb, district engineer of the State Highway Department, Illinois Department of Public Works, with M. W. Embody as resident engineer.

Engineering Education and Life

Technical Training, if Broadened, Should Fit Men for Thousands of Executive Positions Outside of Engineering Field

By Cyrus Townsend Brady, Jr.
Resident Engineer, United States Steel Products Company, Buenos Aires, Argentina

FROM time immemorial man has built, with such degree of elaboration as he was able, objects to be used for his own comfort and convenience. At a certain stage of magnitude and complexity these objects or structures are called "engineering works," and a high degree of coördination of the various forms of man's mental and spiritual faculties then becomes necessary to insure that they may successfully fulfill the sole purpose for which they are conceived—the welfare of men.

Before that purpose is accomplished, these steps have usually to be mounted: (1) Exercises of the imagination—the mind must conceive existence of the project; (2) other minds must be interested in it—promotion; (3) a preliminary study of feasibility, cost and commensurate return, commercial or moral; (4) legal difficulties must be overcome; (5) finance; (6) final investigation, surveys, etc.; (7) the general design as influenced by degree of permanency desirable, future operation and maintenance, transportation, materials, labor, workmanship, etc.; (8) the detailed design; (9) preparation of specifications, letting of contracts, etc.; (10) construction; (11) operation; (12) management and marketing of product; (13) maintenance.

All these steps are of nearly equal importance and no one of them is of the slightest value to the world. Engineering projects are carried out for one reason and one only—that men may use them, and until they are put into successful use they are truly "useless." It is ignorance of this principle which causes woeful misconception in the minds of engineering students, to whom the whole of engineering seems comprised in step 8, although there is a vague recognition of an ancillary importance in steps 6, 7 and 10.

The schools are not entirely to be blamed for such misconception, as it is impossible to instill the absolutely essential habit of accuracy without insistence on the minutiæ of calculations. Yet the standard engineering course does tend to imbue the student with a concept of the engineer as a walking calculating machine who knows how to run surveying instruments. The real engineer is, or ought to be, much more than that. While it cannot be presumed that any one man will possess a mastery of all the steps previously mentioned he certainly must grasp the basic principles of them all. He should appreciate their relative value and recognize that his own activities are merely some of the various subordidnate functions in the one combined operation.

I believe good would come of abolishing half of the elaborate design courses given in the senior year of the ordinary engineering curriculum and substituting work in the lines of finance, promotion, law, accounting, etc. From matriculation to graduation an increasing share of the students' attention should be directed toward the use and the users of "engineering works," instead of entirely to the works themselves. Is there not a larger field for descriptive courses than is usually conceded? I remember studying in preparatory school the old-fashioned course in ancient history, chiefly concerned with names and dates of kings and battles, and the general view gained of the history of, say Greece, was a dreary confusion of the Delphic amphictyony and the hegemony of Athens. Recently I came across Breasted's "Ancient Times" and found it a splendid example of the new method of treatment in textbooks. The people of the early world are presented with their businesses, their ideas, their arts and sciences, their loves and hates, their everyday lives—in fine, as rational human beings. The history seems to live of itself, to move in one great wave of advancing and receding civilization, to compel the reader to recognize his kinship with them of old time—and it never once mentions the Delphic amphictyony. Why cannot engineering subjects be so taught as to kindle the imagination and fire the enthusiasm, not solely as elegant mathematical propositions, like the theorem of the three moments, but more as the very surest indices of our civilization?

Trained in Science, but not "Cultured"

Much has been written for the technical press concerning the "cultural value of the exact sciences" and Herbert Spencer's "unanswerable arguments" for them. Doubtless his arguments are unanswerable. I have not read them. Of course, any argument by so consummate a master of logic would be difficult of answer by us of less powerful mind—and yet the unanswerable arguments do not obviate the fact that many men trained in science are not what we call, for lack of a better word, "cultured." And especially is this true of engineering graduates. However, as engineering is not an exact, but an essentially empiric science, Mr. Spencer's cultural value may not apply to it. Young engineers are only too often afflicted—I know I was—with a half-hidden scorn of nontechnical, nonscientific ideas, occupations and persons, and with an unpleasant cocksureness as to the competency of their own unaided reason to solve correctly every problem presented to it. It is quite typical of the past century's "I am the master of my fate, the captain of my soul" philosophy.

We may grant that the scientific education need not necessarily deaden the poetic and imaginative faculties, and may lay the blame, in the majority of the cases of this common result, directly on the students themselves. It is they who demand more and more of intensive technical teaching and who are intolerant of anything else. Frequently it is only by severe pecuniary sacrifices that they are able to take their course at all, and the feeling that they cannot afford to devote any time to other topics is but natural. Nevertheless, we must deplore the fact that this attitude leads to an unfortunate repression of some of those higher emotions which are inherent in us all.

True Education Needed by the Engineer

It is a sad commentary on our profession that it is necessary to expend so much energy in urging the "benefits of the study of English for engineers" and similar matters. It goes without saying that every educated man ought to pride himself on speaking his mother-tongue correctly, that he should enjoy the amazing wealth of the world's literature, and that he should appreciate it along with all the other arts which crown civilization; nor can anyone be considered a truly "educated" man who lacks discrimination in these things.

Good taste is largely a matter of education, and requires for its full development and expression a certain amount of leisure and especially the atmosphere of refined surroundings. The low wages of the engineer continually react to prevent his acquisition of the means for the satisfaction of those spiritual necessities, and their lack in turn prevents the full development of his character which would enable him to associate with men of affairs, and to overcome that excessive modesty which is the besetting sin of the middle-aged engineer. Finally the engineer's diffidence is a powerful factor in preventing his better compensation. Painful as it may be to admit this "vicious circle" of reasoning, reflection will suggest many examples of its continual effectiveness. It requires a true act of Christian resignation for many an engineer to continue in his profession; but who outside of it ever awards him even a meed of "psychological compensation" in honor and esteem? What engineering school ever brought this to the attention of its freshman class?

The belief that our engineering training fits us only for technical engineering work is the fundamental cause of our, too often melancholy, lot. In hard times the bachelor of arts who took a college course, or two, in music does not feel that he is thereby bound to hunt only for a job as bass-drummer—he takes the first thing that comes to his hand. Yet it seems that our only recourse is to look for vacancies for draftsmen or surveyors. Our training, provided it were only slightly broadened, should fit us for the thousands of executive positions in which a knowledge of engineering principles is of the utmost value. It should make us useful adjuncts to any kind of manufacturing; to the great field of scientific accounting; to banking institutions; to commercial business, not merely as salesmen of construction materials, but also in general office work. The young graduate must get rid of the feeling that his education has been wasted unless he commences work as drafsman, surveyor or inspector. It will astonish him to know that his ability to figure easily and accurately so simple a problem as the net cost in pesos per metric ton from a quotation in dollars per 100 lb. "less 25, 10, 5 and 5" usually impresses the American executive far more effectively than the display of the most profound knowledge of the theory of the elastic arch. The bachelor of science should feel as free as the bachelor of arts to accept any kind of job he can find. Cleaning ink wells, if necessary as a start, will not hurt him, and soon enough he will find that, beginning with his facility in arithmetic, he will be called upon for greater and broader applications of his scientific equipment and powers of thought. Adequate compensation, continuity of employment and the privilege of associating with broadminded men are not difficult of attainment in the commercial world.

In the great increase of American foreign commerce, due to the war, there have been and are now available many openings for engineers and for men of all business classes who are willing to live abroad. Many inducements have been offered to obtain the right kind of man, and therefore one phase of living abroad is seldom mentioned—that is, that the man's wife practically never shares his enthusiasm for fresh worlds to conquer, and she is almost invariably homesick. I have yet to meet one American girl who really likes living continuously outside the United States. They may be plucky enough not to complain, but the separation from their own people tells heavily on them. Whether the inducements offered ever outbalance the disadvantages is a point of perpetual dispute. Bachelors must take this to heart as well as married men, for after living abroad a short while the loneliness of the life will teach them the truth of Benedick's marvelously logical explanation that when he said he would die a bachelor he did not think he would live till he were married.

Federal Highway Council Urges Removal of Snow From Roads

With the advance of winter, the transportation bureau of the Federal Highway Council is calling the attention of state highway officials to the necessity for the removal of snow from highways as a means of preserving state roads and of maintaining all-year traffic service. Melting snow on roads, it was pointed out by officials of the transportation bureau, tends to soften the subgrade and loosen the base under the wearing surface, and this generally results in ruts which require repairing in the spring. The expense of clearing the snow from the roads, it was said, is less than the cost of repairing the roads after excessive amounts of snow have been allowed to thaw upon them. Traffic in winter over snow-covered roads results in more damage to the roads than more frequent traffic in the spring. Snow removal is also being urged by the transportation bureau as an indispensable part of all-year motor-truck transportation.

In advocating the transfer of short hauls from the railroads to motor-truck routes, the Federal Highway Council emphasizes the imperative need for having motor-truck roads free from snow in winter, pointing out that if motor-truck roads are snowbound in winter the short-haul traffic will necessarily revert to the railroads during that period of the year. State highway organizations are urged to obtain the necessary legislation to enable them to remove snow from the highways so that motor-truck transportation will not be unduly delayed during the winter months.

Mixing Concrete by Surface Areas on Actual Work

How Concrete Proportions Are Controlled and Varied on Construction Work of the Hydro-Electric Power Commission of Ontario—Concrete Specified by Strength

By Roderick B. Young
Assistant Laboratory Engineer, Hydro-Electric Power Commission of Ontario, Toronto, Ont.

During the past year there has been a great deal of discussion as to the proper method of proportioning concrete. The old volumetric system—the 1 : 2 : 4 concrete of the past—has been criticised and new methods advocated which proportion the cement and water according to certain characteristics in the aggregate. So far all the discussion, which was started by Prof. D. A. Abrams of the Structural Materials Laboratory of Chicago and L. N. Edwards, then bridge engineer of the city of Toronto, has been along experimental and theoretical lines. The Hydro-Electric Power Commission of Ontario, however, has for some time been studying the theories with a view to their application to practical work, and as a result has developed a method of proportioning which is being used on all of the concrete placed by the Commission, to total over half a million yards in the next three years. Some opposition has been encountered in its introduction, but this has been more because the concrete mixtures have been drier than formerly than from opposition to the system itself. It is not only more scientific in its theoretical basis, but it is providing concretes of the quality specified, and doing this more economically than the old-time methods of proportioning.

The system is based on a very simple foundation built upon a combination of the theories of Prof. Abrams and Mr. Edwards. Prof. Abrams has noted as a result of his experiments that, within the range of workable concrete mixtures, the compressive strength of a concrete bears a definite relation to the ratio between the volume of water and the volume of cement contained in the mixture from which it was made. This water-cement ratio, as it is called, is simply a measure of the quality of the cement paste used to glue the particles of aggregate together. Abrams has shown that for any given set of conditions—same aggregates, same cement, same age of concrete, etc.—concretes of equal water-cement ratio have approximately equal strength regardless of their cement content so long as their mixtures are practicable and workable.

The experimental studies in the laboratories of the Hydro-Electric Power Commission of Ontario corroborate this and have further shown that the mixing water required to obtain concrete mixtures of constant mobility varies as the surface area of the aggregates used. This being so, it follows that to maintain constant strength and therefore a fixed ratio between water and cement, it is necessary to vary the cement also as the surface area. This agrees with Mr. Edwards' surface-area theory.

In practice, concrete has to fulfil two conditions: it must have a strength at least equal to that fixed by the design of the structure of which it forms a part and it must be sufficiently plastic to handle and place properly during construction. It is evident that the first condition defines the quality of cement paste or water-cement ratio of the mix and the second the ratio of cement and water to surface area. If the ratio of cement to surface area and the water-cement ratio is known for any desired strength and plasticity the water content of the mix is likewise fixed. Therefore in proportioning, the cement-area relation need only be considered.

The foregoing forms the skeleton upon which has been built the system now in practical use by the Hydro-Electric Power Commission of Ontario. For any proposed aggregate, tabular relations are experimentally established between strength and water-cement ratio and between cement content and surface area, for one degree of plasticity known as normal or 1.00 consistency. Then if the normal consistency is satisfactory for the particular work in hand, the cement content and water-cement ratio corresponding to the quality of concrete specified are read off the tables and the mixtures proportioned accordingly. If the normal consistency is not satisfactory the consistency is varied by *changing both the cement and water proportionately*, thus maintaining the proper water-cement ratio, until the desired workability is obtained.

How Surface Areas Are Found

Surface areas are determined by the same method as employed by Mr. Edwards in his original investigation. The aggregate is separated by means of testing sieves into its component sizes and the number of particles per unit weight of each size is obtained by count. The assumption is made that these particles are spheres. It is then possible from these counts and the specific gravity of the material to calculate for each size of separation the surface area of the average particle and hence the total surface area in a pound of particles. This information is tabulated as in Table I and put into the form of charts as in Figs. 1 and 2. In calculating the surface area of a particular aggregate it is necessary to sieve it into the same sizes of separation as those used in obtaining the above data. The percentages lying between adjacent sieves are translated as so many pounds of each size material in 100 lb. of aggregate. The surface area corresponding to the weight of each size is read from the surface-area chart or calculated from the tabulated data. The sum of the different values thus obtained is the surface area per 100 lb. of aggregate. This may be changed by simple calculation to surface area per cubic foot.

It has been found experimentally that the dust—that is, anything below the No. 150 sieve—is more comparable to the cement than to the aggregate and that where it does not exceed five per cent it can be entirely ignored both in calculating surface area and in subsequent proportioning.

The actual operation of the method is as follows:

When a piece of construction involving concrete is contemplated a combined field and laboratory investigation is first made to determine the most suitable and economical sources of supply for the necessary aggregates. The extent of this investigation depends on circumstances but usually it consists of reports on deposits, samples from those deposits and field and lab-

TABLE I. SURFACE AREA PER 100 LB. FOR DIFFERENT SIZES OF SEPARATION OF SAND, GRAVEL AND CRUSHED STONE

Pass	Sieve No. Retained	Sand and Gravel Sq.Ft. per 100 Lb.	Crushed Stone Sq.Ft. per 100 Lb.
2"	1½"	23.6	36
1½"	1"	42.7	62
1"	¾"	74.6	124
¾"	½"	130.0	163
½"	No. 6	255	...
No. 6	10	437	...
10	20	875	...
20	35	1744	...
35	65	3490	...
65	150	6975	...

oratory tests of these samples to determine their quality. This work is undertaken as far as possible in advance of actual construction.

Once the source has been determined from which the aggregate is to be taken, a quantity of the material, usually from 3000 to 5000 lb., is shipped to the laboratory for detailed investigations into its concrete-making properties. The first study undertaken is to determine the mechanical analysis of the combined fine and coarse aggregate which will give the most economical mixture, considering both workability and economy of materials. The most economical mixture is one containing the lowest surface area per cubic foot of material which can be successfully handled and placed. These studies are checked in the laboratory by making concrete mixtures of different gradings and observing their mobility and flowing properties.

The quantities of concrete handled in the laboratory are too small to allow of their exhibiting the same characteristics as do large masses of concrete and hence the final decision as to what is a workable mix must be made in the field. Coincident with this work the necessary grain counts and calculations are made to obtain the surface area per pound of each size of these materials and these results are charted.

The next step in the laboratory investigation is to determine for these materials the relation between cement content at normal consistency, water-cement ratio and compressive strength. Using the combination of fine and coarse aggregate giving the grading already determined as most suitable, a series of tests is made in which the cement is proportioned according to the surface area of the aggregate. Water is added to give mixtures of the same mobility. Concrete test specimens are made from these mixtures and tested in compression. These tests establish the relation between compressive strength and cement content at the normal or test consistency and between compressive strength and water-cement ratio for all consistencies, for the relation between water-cement ratio and strength is independent of the consistency and if established for one consistency holds equally for all others. Typical results of such tests are given in Table II. Figs. 3 and 4 are plotted from these data and are representative of a large number of curves obtained in similar manner.

In proportioning cement by surface area the unit of measurement used is the lb. per 100 sq. ft. The number of different proportions in a series of tests depends upon circumstances. Where the work for which the tests are being carried out involves only a few thousand cubic yards of concrete, four sets of five specimens are made proportioned 1.5, 2.0, 2.5 and 3.0 lb. of cement per 100 sq. ft. of area and tested at 28 days. Where the yardage is considerable, six sets of ten specimens with a range of cement from 0.75 to 4.0 lb. per 100 sq. ft. of area are tested at both 28 and 90 days. Where the yardage is very large even more extensive investigations are warranted. In any case less than four sets are inadvisable and more are always to be recommended.

In proportioning water the simplest way is for the operator to add the water until, in his judgment, the mixture is of the required mobility. With an experi-

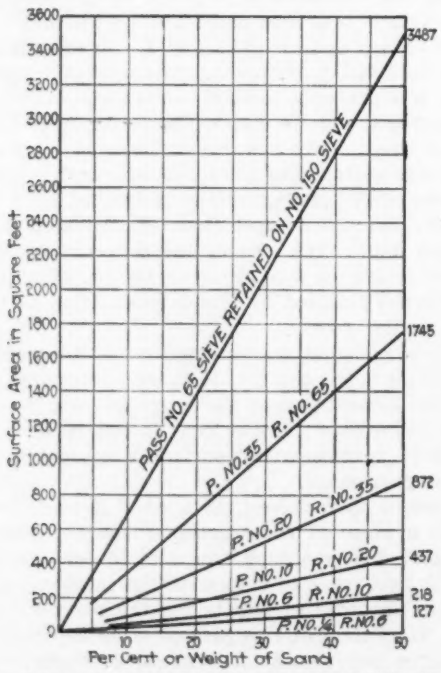

Surface Area in Square Feet
Per Cent or Weight of Sand
PASS NO. 65 SIEVE RETAINED ON NO. 150 SIEVE
P. NO. 35 R. NO. 65
P. NO. 20 R. NO. 35
P. NO. 10 R. NO. 20
P. NO. 6 R. NO. 10
P. NO. ¼ R. NO. 6
3487
1745
872
437
218
127

FIG. 1. RELATION BETWEEN PIT-RUN SAND GRADING AND SURFACE AREA

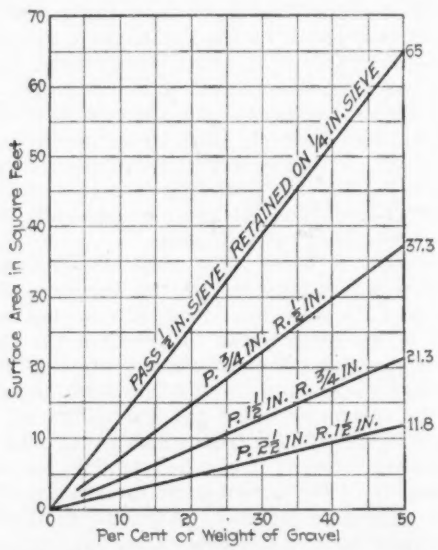

Surface Area in Square Feet
Per Cent or Weight of Gravel
PASS ¾ IN. SIEVE RETAINED ON ¼ IN. SIEVE
P. ¾ IN. R. ½ IN.
P. 1½ IN. R. ¾ IN.
P. 2½ IN. R. 1½ IN.
65
37.3
21.3
11.8

FIG. 2. RELATION BETWEEN PIT-RUN GRAVEL GRADING AND SURFACE AREA

TABLE II. RELATION BETWEEN CEMENT CONTENT, WATER-CEMENT RATIO AND COMPRESSIVE STRENGTH

	Series IB-1						
Cement—Lb. per 100 sq.ft.	0.75	1.5	2.0	2.5	3.0	4.0	5.0
Water-cement ratio	1.994	1.118	0.915	0.780	0.697	0.590	0.526
Compressive strength, lb. per sq in.	548	1337	1791	2290	2851	3426	4158

enced operator this method can be made to yield satisfactory results even with a wide range of cement ratios and differently graded aggregates. In the work of the Commission, however, a formula is used for determining the correct amount of water required to bring a mixture to the proper mobility. This formula is based on a theory as yet only partially established and its discussion is without the scope of this paper. It is not general in its application and its constants have to be determined for each different class of material. They are derived from the tests made when studying the relative mobility of the different combinations of aggregates. With this formula, mixtures have been obtained the mobility of which was so nearly equal that no difference could be detected by any means at our disposal.

The concrete specifications of the Commission provide for four classes of concrete designated A, B, C, and D. Class A concrete is required to be of such quality as to show a minimum compressive strength of 2500 lb. per sq. in. at the age of 28 days when tested in accordance with the standard methods of testing of the Commission. Classes B, C, and D are required to have minimum compressive strengths of 2000, 1500 and 1000 lb. per sq. in. respectively under the same conditions. This form of specification has been adopted because it is considered more logical to specify the property desired of the concrete than to give a formula for the mixing of its ingredients.

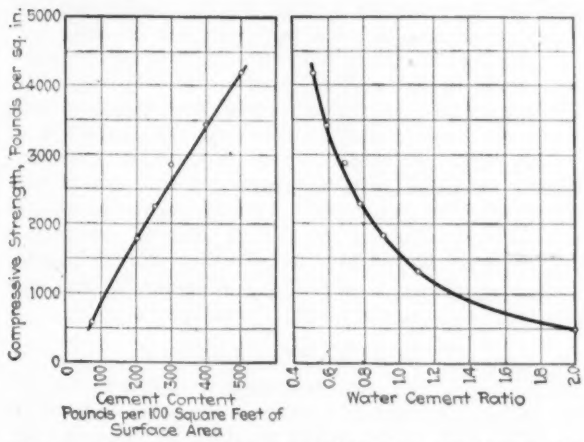
In designing concrete mixtures to fulfill these specifications it is customary to allow a margin of from 300 to 500 lb. per sq. in. to take care of field conditions. A 300 lb. margin should be ample, however, if the operations of proportioning and placing are subject to careful inspection. Allowing a 300 lb. margin of safety, the ratio of cement to surface area which corresponds to each of the above classes of concrete would, in the case of the materials used in the tests of Fig. 3, be those shown in Table III. These, however, hold only for concretes of the same plasticity as that used in the tests. As before noted, compressive strength depends on the water-cement ratio of the paste. From Fig. 3, therefore, is obtained the range of water-cement ratio

TABLE III. CEMENT RATIO AT NORMAL CONSISTENCY AND WATER-CEMENT RATIO CORRESPONDING TO CLASSES OF CONCRETE IN SPECIFICATIONS

Class	Minimum Specified Compressive Strength, Lbs. per Sq.In.	Cement, Lbs. per 100 Sq.Ft. Surface Area, Normal Consistency	Range of Water Cement Ratio Min.	Max.
A	2500	3.18	0.68	0.74
B	2000	2.58	0.78	0.86
C	1500	2.08	0.91	1.04
D	1000	1.48	1.14	1.37

which corresponds to both the minimum compressive strengths specified for each class and to that minimum compressive strength plus its margin of safety. The former is the maximum water-cement ratio allowable and must never be exceeded if concrete of the proper quality is to be obtained. The latter is the water-cement ratio normally worked for. These minimum and normal water-cement ratios are likewise given in Table III.

By means of these tests and investigations all the data required for proportioning concrete mixtures are obtained. The next step is to apply these data to setting proportions in the field.



FIGS. 3 AND 4. CURVES ESTABLISHING RELATION BETWEEN COMPRESSIVE STRENGTH, WATER-CEMENT RATIO AND CEMENT CONTENT AT NORMAL CONSISTENCY

In the field the first step is to obtain the surface area per batch in order to proportion the cement. This requires, first a mechanical analysis of the different aggregates used, a determination of their weight per cubic foot and a knowledge of their moisture content and of the proportions in which the different aggregates are to be combined in the mix.

The proportions for the different aggregates are worked out using as a basis the data obtained by the laboratory in the preliminary studies of the most economical mixture. The aim is to get the leanest concrete which is workable, gives a good surface, has the requisite density and at the same time fulfills the requirements for water-cement ratio and hence for strength. Although the preliminary studies of the laboratory are of great value in obtaining this, the final proportions should actually be set in the field, for to some extent they depend on the type of structure being built, whether mass or reinforced, on the amount and spacing of the reinforcing, on whether the sections are thick or thin, on the maximum size of stone used and the quantity of this maximum size present in the coarse aggregate, on the consistency, on the quality of labor, etc.

The sieve analysis and other tests referred to are carried out by the field engineer with equipment supplied him for the purpose. The sieve analyses and weight per cubic foot determinations are performed similarly to those in the laboratory, except that the latter is made without drying the aggregate, as is laboratory practice. From the data of these tests and the surface area charts of Figs. 1 and 2 the surface area per 100 lb., or per cu. ft., and hence per batch, are determined.

The weight of cement required for normal or test consistency is found by multiplying the surface area per batch by the proper cement factor (Table III) for the class of concrete it is sought to obtain. This weight is usually given in terms of bags of cement. The quantity of gaging water is then calculated from the minimum water-cement ratio (Table III) corresponding to same class of concrete. In calculating the water, allowance must be made for moisture contained in the aggregate in its natural state. This has been found to be seldom less than two per cent, and is usually between

three and four per cent. This last is a safe figure to use except directly after a rain when six or eight per cent. moisture should be allowed for. It is better practice, where circumstances permit, to determine the moisture content of the aggregate by actual test but this is not always possible. Experience has shown that if these tests are made a few times under different weather conditions, the engineer can then judge the proper moisture corrections of his aggregate so closely that only occasionally check tests become necessary. Moisture tests do not have to be made upon the coarse aggregate unless it is mixed with considerable fine aggregate, as the amount present is negligible.

Add Both Water and Cement

If the normal or test consistency is too dry for the work in hand, cement and water in the same proportion are added until the required mobility is obtained. If the consistency is wetter than necessary the cement and water are reduced in the same manner. The new consistency is defined in terms of its relation to the normal or 1.00 consistency. In further proportioning in which the same mobility is desired, the cement content for normal consistency is multiplied by this consistency factor, that is, by 1.10, 0.90, etc., as the case may be, and the water proportioned to give a cement paste of the proper water-cement ratio.

Natural aggregates are subject to changes in their grading and it is therefore necessary to test them frequently and alter the proportions of the concrete mixtures to suit. This involves a repetition of the mechanical analyses and calculations for surface area described before. It is not usually necessary to change the combination of the aggregates except where the variation in the materials is considerable, as when, in using a mixture of bank sand and crushed stone, the percentage of gravel in the former changes from, say, 25 per cent. to 40 per cent. When such occurs and changes in the proportions of the aggregate are necessary, the combinations which give the nearest approximation to the ideal grading are determined as was done in fixing the original proportions.

Finally samples of the actual concrete produced are taken periodically, made into standard test cylinders and sent into the laboratory. It is our practice to take these directly from the forms, to take two or three samples at a time and to test these at 28 days. Samples are taken whenever it is necessary to change the proportions, and oftener if deemed advisable by the engineer in charge. Careful record is kept of the portion of the structure represented by the samples, the proportions used, the approximate water-cement ratio and all other pertinent data.

Certain features peculiar to the use of this method bear emphasis. If the contractor is required by the specification to produce concrete of definite quality, then it is evident that to do so he must use concrete mixtures having water-cement ratios not greater than those corresponding to the minimum requirements of the specification. Where this is insisted upon the question of the proper consistency to use under any given set of conditions is one that can be left to the contractor for solution. The wetter mixes require more cement, the drier more labor to handle and place. The contractor will balance these two factors and may be depended upon to use the consistency that is cheapest. This will almost always be found to be the driest consistency practicable for the work in question.

The method allows the use of bank-run aggregates or mixtures of these with crushed rock or gravel. The former are seldom, if ever, economical in cement, but their use is sometimes advisable where the size of the job or other consideration makes their treatment unprofitable. The Commission has regularly used a mixture of screened crushed rock and bank sand and gravel. This practice has been found entirely satisfactory and the mixtures used have been economical in cement and no trouble has been experienced with them in getting concretes of the required strength.

Under ordinary conditions the only changes in proportions to compensate for changes in the aggregate occur in the cement. This is the easiest material to handle; it is also the most expensive. Changes in the proportions of the aggregates usually involve a disruption of the system of handling materials, give rise to confusion among the workmen and increase the difficulty of inspection. Changes in the quantity of cement involve a change in the routine of only one man, whose intelligence is usually superior to that of the laborer handling the aggregate. The proportions are more easily checked and inspection is simplified.

Proportioning by the surface area method allows the use of a smaller margin of safety than is permissible when the proportions must cover a wide variation of materials. To take advantage of the economies in cement, possible where this smaller factor of safety can be used, it is necessary to proportion the cement more closely than is customary in the field. Splitting a bag of cement in half is as fine a division as is ordinarily considered feasible in practical work. Where small mixers are used this is not enough, and some provision should be made to further subdivide a bag. An arrangement is not hard to devise and saves its cost many times over. If a quarter of a bag of cement can be saved on each one-half yard batch in a day's run of 160 cu.yd., it means a saving of 40 bags, or from $25 to $40, which will pay handsomely for the extra labor and equipment involved. On large mixers the saving does not usually warrant the extra trouble and expense. The Commission has under consideration proportioning the cement entirely by weight; eliminating, wherever possible, the bag as a unit of measurement.

Cost of Studies Moderate

The cost of the investigations is moderate. It is hardly debatable that an investigation of the concrete materials should be made prior to any work of importance. Experience has too often shown the danger of neglecting this precaution. Few will quarrel with the statement that tests should be made of the concrete produced. These precautionary measures are common to all methods, only here the laboratory investigations are carried out differently. Our experience, which covers the usual methods as well as those described here, has demonstrated that the studies and investigations for the latter cost less and yield more valuable information than those for the former. Their cost runs from $400 to $1000, depending on the size of the job, its distance from, and the experience and organization of the laboratory making the tests. These costs are moderate, considering the benefits to be gained. We are making an endeavor to develop approximate meth-

ods for use on the smallest jobs of a few hundred cubic yards or less. We believe it will soon be possible to make such studies as are necessary for these at a cost of from $50 to $75, and still retain the essential features of the method. It will usually be found that the cost of such investigations as are required will be offset by the savings effected by the more accurate proportioning possible.

Method Good in Competition

It will be of interest here to cite a recent experience of the Commission. On a job upon which the surface-area method is being regularly used a structure is also being built for an outside firm using methods specified by their engineers. On the same job another structure in which concrete of the same quality is called for is being built, using the surface-area method. Materials for the two structures are from the same sources and are mixed and placed with similar equipment. The results, shown in Table IV, from seven consecutive tests of field concrete specimens, some of which were

TABLE IV

Cylinder No.	Class of Concrete	Proportions	Compressive Strength, Lbs. per Sq.In.	Method
90	B	1:2:4	2000	H. E. P. C.
91	B	1:2:4	2480	H. E. P. C.
92	B	1:2:4	1960	Foreign
93	B	1:2:4	1470	Foreign
94	B	1:2:4	1800	Foreign
95	B	1:2:4	1510	Foreign
96	B	1:2½:5	2090	H. E. P. C.

from each of the jobs and which represent concrete placed simultaneously, illustrate the kind of results obtainable with the two methods.

In the pouring represented by the last specimen the mix had been changed to a 1 : 2.5 : 5, yet the quality and mobility of the concrete were maintained at the standard desired.

The surface area method as here described has been found to take well in the field. The laboratory studies involved in its use are cheaper than those required for other methods and obtain information of wider application. The method has been found to give a means of estimating the relative economy of different aggregates because two factors, workability and strength, which were formerly variable have now been reduced to constants. The success so far obtained in its use has been so encouraging that it is now expected it will be used on all work undertaken in future by the Commission.

Work of the Los Angeles Municipal Repair Shop

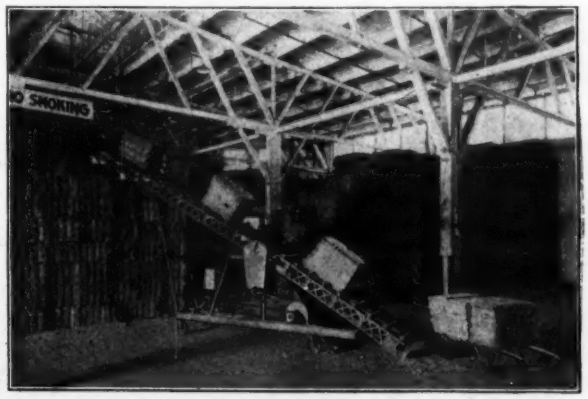
The municipal shop operated by the Board of Public Works of Los Angeles, Calif., does repair work on the following city-owned equipment, according to the annual report of the engineering department of Los Angeles for the year which ended June 30, 1919: Nineteen steam fire engines; 14 motor-driven fire engines; 40 hose, ladder and other fire-department trucks; 43 motor trucks used by other city departments; 105 passenger automobiles; 46 motorcycles; three asphalt pavement surface heaters; a municipal asphalt plant; an oil-heating plant; two rock-crushing plants; and miscellaneous equipment. During the fiscal year, 4504 jobs were completed, aggregating $120,289 in cost. A detailed card record is maintained for each automobile repaired. These repair data for the year covered are given in tabular form.

Freight-Handling Equipment at the Port of Seattle

Public Operations Tend To Encourage Experiment and Develop Labor-Saving and Freight-Handling Devices

By George F. Nicholson
Chief Engineer, Port of Seattle

SEVEN years ago the Port of Seattle entered upon an extensive program of port improvements, and established the policy of sparing no reasonable expense or effort in providing the very best facilities and equipment for the class of business expected. Under this policy a great deal of experimental work with freight-handling and labor-saving devices has been carried on, and the port has been provided with more and better mechanical freight-handling equipment for handling



CONVEYORS FOR STACKING BALED HAY AND SACKED WHEAT

miscellaneous cargoes, the writer believes, than any other port in the United States or Canada. This conclusion was reached after the writer visited last autumn all Atlantic, Gulf and Pacific ports.

Public operation has apparent advantages over private in the matter of labor-saving and freight-handling devices. Under public control, when a labor-saving device is found to be an improvement on methods previously employed, it is provided and put in service, and employees can be encouraged to work out new plans or to suggest improvements on equipment in use. In contrast with this, the private dock owner is slow in taking up the matter of providing new mechanical equipment. As an illustration, when the Port of Seattle completed the Stacy St. pier, two electric tractors and a number of trailers were bought and assigned to it for handling cased salmon.

Up to that time no tractors had been used for work on the Seattle waterfront. However, many visitors came to study the operation of the new tractors, and within three weeks four electric tractors were on order for privately owned docks in the same port. This is not an isolated instance. It typifies the willingness to pioneer which has meant progress.

The development of the vegetable oil handling facilities at Seattle was described in *Engineering News-Record* of July 31, 1919, p. 204, and the portable stacking elevator, which solved the gunny-bale problem, in the issue of Nov. 13-20, 1919, p. 855.

Where the leasing system is in vogue, as in San Francisco, New York and other ports, the harbor board provides the facilities such as docks and warehouses and places upon the lessee the responsibility for providing handling equipment. Under such conditions, the writer believes, the lessee will be very slow to purchase handling equipment. The Port of New Orleans and the Public Dock Commission of Portland have already realized this, and their policy is now to work gradually into the publicly operated system.

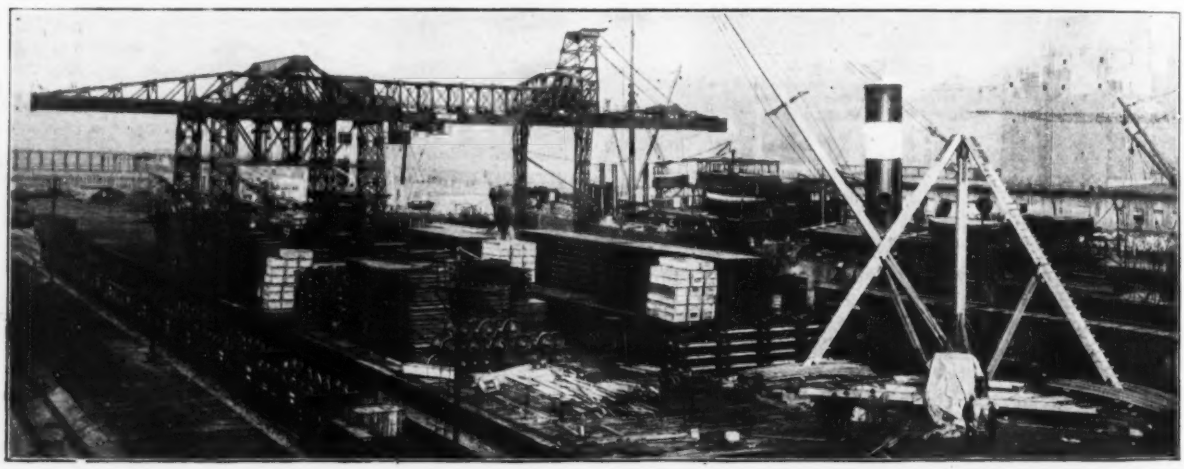
The mechanical handling equipment of the Port of Seattle as now installed is valued at approximately $950,000. This, of course, does not include sprinkler and lighting systems or water-supply. The freight-handling equipment may be divided into two classes, heavy and light. The heavy equipment is used principally for handling export cargo consisting chiefly of iron and steel and lumber. This includes gantry cranes, portable locomotive cranes, stiff-leg derricks and a 100-ton shear-leg derrick. It is also contemplated to install a 100-ton revolving hammerhead crane on the new pier B, now under construction at Smith's Cove. This heavy equipment has been found indispensable in the export trade, and we do not know of any new equipment that could handle this class of commodities with more dispatch and economy.

The other class of equipment is the light equipment for handling the import cargo, which consists chiefly of large and small boxed, baled and sacked goods. This equipment includes inclined power conveyors, portable electric stacking elevators, stationary electric elevators, electric tractors with the necessary trailer, and other similar devices.

In case of sacked goods, such as wheat, sugar, beans, rice, and also in the case of baled hay and similar light bales, inclined power conveyors are used almost exclusively, and are operated in the same manner as the stacking elevators—that is, the inclined conveyor is placed at the pile and the truckers bring their goods to it. The crux of the problem of economically handling baled and sacked freight is in the stacking, because it is in that phase of the handling that the labor cost increases most rapidly. It is hard to improve on the two-wheel truck for short hauls, and it is because of this that many proposed mechanical handling schemes fail—that is, they attempt to carry miscellaneous freight from the ship's side to the interior of the shed. It will be found that even with the high cost of labor on the short hauls the two-wheel truck is cheaper.

A great deal has been said about the use of semi-portal cranes along the shed, and monorail or overhead rail systems for transit inside the sheds. The writer has come to the conclusion, however, that on account of the great number of markings on import cargoes coming into Seattle and the great amount of sorting necessary, the overhead monorail system would fail. For the freight that comes in sacks, boxes or bales, the use of light portable stacking equipment inside the shed served by two-wheel trucks seems to be the most economical and satisfactory method thus far developed.

A very considerable saving in the cost of handling freight is possible where transfer can be made between railroad cars and ships, or vice versa. It is essential to have two shipside tracks on the wharf for this operation. A very large proportion of the export cargo is handled in this manner in Seattle, and it will be found that the ship's tackle in this direct loading is as efficient as an expensive dock crane.



TRANSFERRING FREIGHT AT SMITH'S COVE PIER, SEATTLE, WITH 100-TON GANTRY CRANE

Seattle has found it desirable to use a special type of elevator for handling freight from one floor level to another. The last one installed has a capacity of nine tons and a 10 x 24-ft. platform which will accommodate six trailers at one time. In connection with the new Smith's Cove Terminal the installation of a much larger elevator, with an 11 x 40-ft. platform, is being considered. This would accommodate two tractor trains of five trailers each, or a total of 10 trailers, the tractors being used on either floor for hauling the trailers between the elevator and the pile.

Ship conveyors for the loading and unloading of ships are considered a most essential part of the port's equipment. For the accommodation of the second floor of the two-story transit sheds, an outside portable platform, moved to any location alongside the shed, is found very useful. With this equipment it is possible to deliver freight, with the aid of the ship's tackle, direct to the second-floor level with as much ease as it could be unloaded on the first-floor wharf. In some cases, at extreme low tide, it has been found impossible to reach the second-floor platforms with the short booms

in use on some of the ships. This difficulty can be overcome by replacing the shorter booms with 50-ft. and 60-ft. booms, the latter being kept as spare booms on the wharf for use in such emergencies.

The installation of loading-out chutes, running from the second-floor level to the cars on depressed tracks or outside platform surface tracks and also the ship's hold on the water side, is important. With these inclined gravity chutes it is possible to load out goods from the second floor into cars very cheaply, and in actual practice it has been demonstrated that some sacked freight, for shipment by rail, can be loaded into cars more economically by use of gravity chutes from the second floor than it could have been trucked into cars from the first floor. By hinging gravity chutes to the portable second-floor platforms referred to, the result is, in effect, portable chutes which may be spotted in front of any car door in a long string of railroad cars located on the outside wharf tracks.

When heavy freights, such as iron, steel and lumber, are being handled over the open-wharf section, the locomotive cranes are kept in almost constant operation. They are used in loading and unloading ships and also in assembling cargo of this character on the wharf in order to expedite clearing a vessel after it has docked. Being portable, these cranes when not in operation can be used in connection with the piling of heavy materials on open storage property in the rear of terminals.

The 100-ton structural-steel shear-leg derrick on the Smith's Cove pier, shown in a view herewith, has been a most valuable piece of equipment for making heavy lifts and has paid for itself time and again, but it can be used to advantage only when heavy lifts are to be made direct from railroad car to ship or vice versa. If it is necessary to store a heavy piece of freight on the wharf it must be loaded on a railroad car with the derrick and then taken off again by some other means. A revolving crane would eliminate this trouble, and heavy loads could be placed for storage at any location on the wharf within the radius of the crane.

In equipping pier B, which is being built alongside the present Smith's Cove pier (pier A) the previous experience of the port will be of advantage in selecting freight-handling equipment. For example, instead of a shear-leg derrick, such as the one just mentioned, the next pier will have a 100-ton stationary revolving crane. There will also be two 10-ton portable gantry cranes on the open wharves of this new pier. These gantry cranes, although specialized equipment, resemble an elevated locomotive crane that operates back and forth the full width of the open wharf on a gantry bridge which travels the full length of the wharf.

It will be possible with this equipment to assemble cargo on the open wharf or to transfer it from the cars situated on any track on the pier. Such cargo can then be moved from the wharf to the ship's hold, or it will be possible to transfer cargo, from cars on the depressed tracks in the center of the pier, direct to the ship, without rehandling. This type of equipment will be a great improvement over the gantry crane in service on pier A, which, it must be admitted, has not proved entirely satisfactory. There are two serious drawbacks in the operation of the pier A gantry, as follows: (1) As it is of the underslung type of gantry crane, it has been difficult to handle long pieces of lumber and long bar-steel, because the bracing connecting the legs that support the gantry bridge interfere with the transfer of this freight from one side of the wharf to the other or from the wharf to the ship; (2) the shipside leg of the gantry crane is located so close to the face of the dock that it is impossible to move the gantry bridge along the wharf at certain stages of high tide, on account of the interference of the gantry bridge with the ship's rigging.

New Specifications for Public Health Officers

Abstract of Paper Read Before Sanitary Engineering Section of American Public Health Association Convention, October 27-30, 1919

By Morris Knowles and Maurice R. Scharff
Consulting Engineers, Pittsburgh

ABOUT seven years ago the authors presented before the Sanitary Engineering Section of the American Public Health Association at Washington, D. C., a paper entitled "Public Health Service—Not a Medical Monopoly." This paper showed that existing state laws required 172 out of 298 members of state boards of health, and 32 out of 46 state executive health officers or commissioners of health, to be physicians; and it upheld the thesis that the degree of Doctor of Medicine was not the only necessary, or indeed the best, qualification for a health executive, and that the cause of public health would be advanced if every state would remove the restriction limiting public health service to the medical or any other single profession, requiring instead that health officers should be trained and experienced in sanitary science and public health and qualified by administrative ability and judgment to perform the manifold functions of the modern public health officer.

Let us state at the beginning that our thesis was not in any sense that a medical man may not be well fitted to fill public health positions, or that a sanitary engineering course is better preparation for such work than a medical one. In fact, we would go so far as to say that a doctor of medicine who had had thorough training in sanitation and public health and who possessed the necessary administrative ability and judgment would probably be better qualified than a member of any other profession with similar education to fill such a position. What we did emphasize was that special training in public health, and administrative ability and experience, were all more essential than the medical degree. In other words, as Prof. C-E. A. Winslow put it in the discussion of the 1912 paper, we would consider a man with both kinds of training preferable to one with either kind alone; but would much prefer a man who knew public health and not medicine to one who knew medicine and not public health.

Since 1912 a number of developments have occurred which appear to the writers to justify the conclusion that there is a general agreement upon these "new specifications for health officers."

Crystallization of Opinion—Numerous expressions of opinion could be quoted from public health literature since 1912 to show the growth and development of the opinion that the ideal health officer must fulfill the new specifications. Dr. W. S. Rankin said in his paper be-

fore the American Public Health Association convention at Jacksonville, Dec. 3, 1914:

There is a prevalent error especially pronounced and dangerous to controvert in medical assemblages to the effect that the average physician will make, on his appointment or election to a health office, an efficient health officer. There is just as much sense in claiming that the average physician is a dermatologist, a pathologist, an ophthalmologist, a surgeon or any other specialist as that the average physician is a health officer whenever an undiscriminating public puts him where a health officer is supposed to be. The efficient health officer is a specialist—as much a specialist as is the surgeon or the ophthalmologist.

Assistant Surgeon General W. C. Rucker, of the U. S. Public Health Service, said in his paper on "A Program of Public Health for Cities" before the Cincinnati convention of the American Public Health Association, Oct. 24, 1916:

Unfortunately, health has been considered in the past only as a medical problem, and the pendulum has been enthusiastically swung so far that health is almost regarded as an artificial state to be achieved and maintained solely through the interposition of medical safeguards. With entire consistency, health wardenship of cities has been committed solely to physicians, those who by training have been taught to consider the pathological in human life, the symptomatology and evidences of disease rather than the great basic, underlying essential factors which enter into and are the vital part in the creation, spread and perpetuation of sickness. Expert knowledge of disease is absolutely necessary for the work of health departments, but cannot be the foundation of a broad, municipal health policy.

In the discussion of this paper, Dr. J. N. Hurty said:

We must all agree with Dr. Rucker that in the past public health has been considered as too strictly a medical matter or a physician's problem. We have all come to recognize that efficient health wardenship requires something more than a knowledge of the diagnosis and the treatment of disease.

And in the same discussion, Dr. Henry F. Vaughan said:

Dr. Rucker has stated that health in the past has been considered solely as a medical problem, as an artificial state to be achieved and maintained solely through the interposition of medical safeguards. It seems to me that there are undoubtedly many phases of public health administration which can be handled more effectively and more efficiently by the business man or the engineer or by others.

Public Health Education—In 1913 the School of Public Health of Harvard University and the Massachusetts Institute of Technology was instituted. Other schools have followed the same line of development, and in 1918 Prof. Eugene C. Howe (*American Journal of Public Health*, Vol. VIII, p. 600) reviewed the courses of twenty institutions in the United States and Canada conducting special professional courses in public health, leading to degrees, certificates or diplomas in this subject. Among those institutions might be mentioned New York University, Johns Hopkins University, Ohio State University, Tulane University, Universities of Colorado, Pennsylvania and Wisconsin, Yale University, etc. It is no longer necessary, therefore, to employ sanitary engineers as health officers, as was formerly the case, because they were the only men available with a reasonable degree of special training in sanitary science and public health. The supply of trained health officers and their assistants, however, is still deficient, and the facilities for training of this kind should be increased and improved.

Legislation—Since 1912 at least two of the states have improved their public health legislation by incorporating into law the new specifications for health officers. Thus, Ohio, which formerly had a State Board of Health of seven, of which the Attorney General was an ex officio member, and a state health officer for whom no professional requirements were specified, passed a law in 1917 providing for a Commissioner of Health who must be "a physician skilled in sanitary science," and for a Board of Health to consist of the Commissioner and four other members, "at least two of whom must be physicians with training and experience in sanitary science." Still more recently, in 1919, New Mexico passed a law providing for a State Board of Health of three persons, not more than one of whom shall be a licensed physician; and a Commissioner, to be appointed by the State Board of Health, and who must be "a person having experience and special training in sanitary science and public health administration."

Sanitary Corps of the Army—Some of the most interesting examples of recent recognition of the necessity of securing health executives from outside the ranks of the medical profession have been afforded by our experience in the great war, and one of the best of these is found in the creation of the Sanitary Corps of the Army.

Paragraph 1386 of the Army regulations describes the duties of the Medical Department of the Army as follows:

The Medical Department is charged with the duty of investigating the sanitary condition of the Army and making recommendations in reference thereto, of advising with reference to the location of permanent camps and posts, the adoption of systems of water supply and purification and the disposal of waste, with the duty of caring for the sick and wounded, making physical examination of officers and enlisted men, the management and control of military hospitals, the recruitment, inspection and control of the enlisted force of the medical department and of the nurse corps, and furnishing all medical and hospital supplies except for public animals.

The qualifications required of officers commissioned in this corps are that they shall be physicians, of age 21 to 32, and graduates of a reputable medical college. The requirements for a commission in the Medical Reserve Corps are that the applicant shall be a reputable physician (M.D.), in good standing in the community, in the active practice of his profession, licensed to practice medicine in the state where he resides, between 22 and 55 years of age, a citizen of the United States, and physically and professionally qualified.

When these qualifications are compared with the duties quoted above from the Army regulations, it will be easy to understand why, at the beginning of the war in 1917, it was recognized that these specifications were not complete for the officers required to fulfill these functions, and the Sanitary Corps of the Army was instituted. The qualifications required by the order creating this corps were as follows:

The officers of said corps will be provided by assigning officers of the Medical Reserve Corps thereto, or by the appointment of citizens of the United States who are found under regulations established by the Secretary of War to possess especial skill in sanitation, in sanitary engineering, in bacteriology or other sciences related to sanitation and preventive medicine, or who possess other knowledge of special advantage to the Medical Department.

The sanitary engineers, bacteriologists and chemists

of the Sanitary Corps rendered signal service in connection with the protection of the health of our armies in camps and cantonments in America, and in France. Unfortunately, however, it is understood that provision has not been made either to continue the Sanitary Corps as a permanent part of the Army, or to provide a reserve in which the experience gained by this corps during the war may be conserved for future emergencies. The discrepancy between the functions to be performed by the Medical Corps and the Medical Reserve Corps and the qualifications required of their members is as great today as it was at the beginning of the war in 1917.

U. S. Public Health Service—A somewhat analogous situation exists with respect to officers commissioned in the U. S. Public Health Service. To obtain a commission in this organization, an applicant must be a citizen of the United States, a graduate of a reputable medical college with one year's experience in a hospital or two years' private practice of medicine. These requirements have not changed substantially since the service was known as the Marine Hospital Service. Meanwhile, the Public Health Service has extended its activities to include a wide range of sanitary work; and since 1912 it has been specifically authorized by law to "study and investigate the diseases of man and the conditions influencing the propagation and spread thereof, including sanitation and sewage, and the pollution, either directly or indirectly, of the navigable streams and lakes of the United States." During the war, a vast extension of this sanitary work took place, covering the sanitation of extra-cantonment zones, extensive investigations of industrial hygiene, and assistance and advice on many sanitary engineering problems of water-supply, sewage disposal, etc. (see "War Activities of the U. S. Public Health Service," by Benjamin F. Warren, assistant surgeon general, and Charles F. Bolduan, chief of the Section of Public Health Education, U. S. Public Health Service).

It is of course true that, even prior to 1912, the Service employed certain pharmacists, technical assistants, etc., and that later, but prior to the war, the new work embarked upon required the addition of sanitary engineers, chemists, bacteriologists and other non-commissioned sanitary assistants. It remained for the war, however, to bring out the inadequacy of the commissioned personnel to assume responsible charge of the sanitary work of the Service in such an emergency. At the Conference of State and Territorial Health Officials, held April 30 to May 3, 1917, therefore, resolutions were adopted calling for the creation of a Public Health Reserve; and although the resultant legislation met with many vicissitudes in Congress, it was finally passed on October 27, 1918. This measure provided for the creation of a Public Health Reserve, and that:

"The President alone shall be authorized to appoint and commission in the said reserve such citizens as, upon examination prescribed by the President, shall be found physically, mentally and morally qualified to hold such commissions."

The personnel of this reserve was assembled long prior to the enactment of the legislation authorizing commissions, and this force, supplemented by units drawn from the Sanitary Service Bureau of the American Red Cross, permitted the Public Health Service to play an invaluable part in protecting the health, both of our troops and of the civilian population, under the unusually difficult conditions created by the war.

Fortunately, the life of the Public Health Reserve was not limited to the duration of the war, as the enabling measure provided that "said commission shall be in force for a period of five years, unless sooner terminated in the discretion of the President." And there is great promise in the existence of this trained body of sanitarians, ready for call in any national emergency—especially as the after-the-war program of the Service (see Supplement No. 35 to the "Public Health Reports") proposes to provide the members with opportunities for intensive training in public health for short periods at stated intervals, and also to order members of the reserve to active duty from time to time to participate in important field work.

Public Health Service Commissions

The provision of this reserve, however, does not completely meet the needs of the situation. The work of the Public Health Service in the future will be in larger and larger proportion devoted to sanitation, and in less and less measure restricted to the original work of the Marine Hospital Service for which the qualifications for permanent commissions were designed. One cannot but be impressed with this fact in examining the after-the-war program to which reference has been made above. It is proposed to carry out this program by the cooperation of Federal, state and local health authorities, and the Federal-aid extension principle is recommended. Among the subjects included in the program are industrial hygiene, rural hygiene, prevention of diseases of infancy and childhood, surveys of water-supplies, introduction and extension of methods of water purification, pasteurization of milk supplies, inspection of production and distribution of milk and milk products, extension of water carriage sewerage systems, establishment of standards of permissible pollution of streams, lakes and rivers used for water-supplies, malaria prevention, drainage, control of venereal disease and of tuberculosis, sanitary supervision of railways, enactment of proper building ordinances and sanitary supervision of housing, promulgation of standards for sewerage and sewage disposal, standard specifications for safe water and water purification, etc.

The mere enumeration of these subjects seems to the writers to suggest the desirability of revising the requirements for commissions in the Public Health Service, and of making provision in the permanent commissioned personnel for sanitarians whose training and experience qualify them especially for the work to be done.

Conclusion

The proposals brought forward in this paper may be summarized as follows:

1. The new specifications for health officers require that such officers be qualified, trained and experienced in sanitation, public health and public health administration.

2. A medical degree is not a satisfactory substitute for the requirements of this new specification, but it is a desirable, though not a necessary supplement thereto.

3. The cause of public health would be advanced if this new specification were incorporated in national,

state and municipal laws relating to the appointment or commissioning of health executives.

4. A permanent Sanitary Corps, and a Sanitary Reserve Corps, the members of which conformed to the specifications outlined above, would be a desirable addition to our Army.

5. The Public Health Reserve is a real accomplishment, to be developed and supported in every possible way. In addition, the commissioning of sanitarians in the Public Health Service itself would contribute to the important sanitary work which that Service will, in future, be called upon to do.

Big Spoil Dump To Cover 200 Acres Maximum Depth of 60 Feet

Excavation From Queenstown-Chippawa Canal To Total 15,000,000 Cubic Yards Being Transported to Dump in Electric Trains

PRACTICALLY all of the excavation from the Queenston-Chippawa power canal now being built by the Ontario Hydro-electric Power Commission around Niagara Falls had to be wasted. At one place a deep gorge crosses the line of the canal, and the nearby excavation to the amount of 1,500,000 yd. is being used to fill the approach gulleys, but most of the remainder of the dry cutting, to the amount of 15,000,000 cu.yd., is being spoiled in a dump which is merely a dump to get rid of the material.

There is in all about 10,000,000 cu.yd. of dry-earth excavation on the canal, but about 1,000,000 yd. of this will go to the small dumps. Rock excavation will total 4,700,000 cu.yd., in place of which 500,000 yd. will be used for concrete aggregate and 500,000 yd. for riprap, leaving 3,500,000 for the main dump and 200,000 to other dumps. As the rock will expand about 180% in breaking up and dumping, the big dump will have to take some 6,300,000 cu.yd. of broken rock.

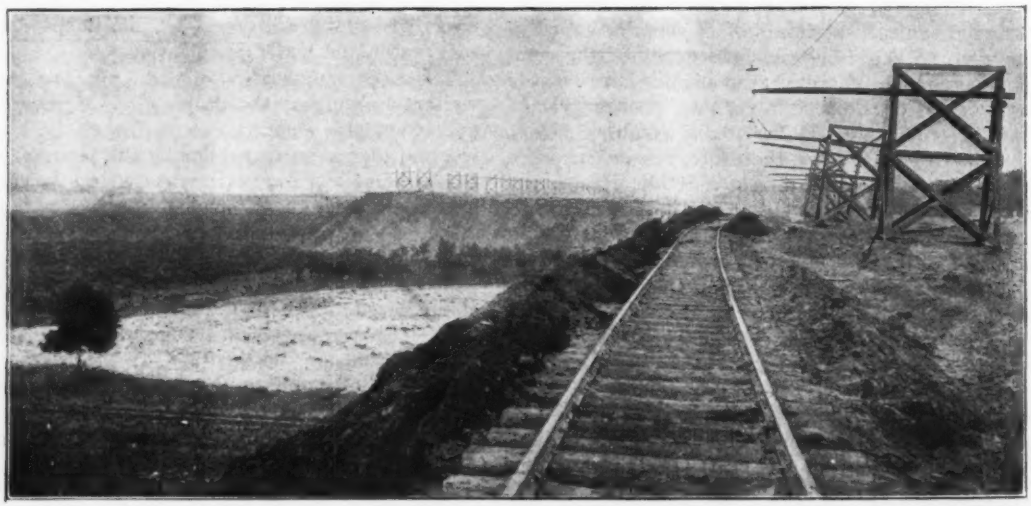
This spoil dump is located about two miles to the northwest of about the middle of the canal, on property which was formerly a prosperous farm and orchard. About 240 acres was purchased for the purpose, but only 200 will be filled, according to present plans. The average fill over this entire area will be about 46 ft. with a maximum fill of 60 feet.

The fill is reached by a double-track spur of the construction railway which parallels the whole canal. This

DUMPING STONE FROM THE CENTER TRESTLE

is a double-track standard-gage road of a type quite suitable for permanent way, although there are no present plans for its use beyond the construction period. It is laid with 70 and 85-lb. rail on well ballasted track, with a maximum grade of 1%, compensated. The whole line is electrified, the dump-car trains being drawn by 50-ton electric locomotives.

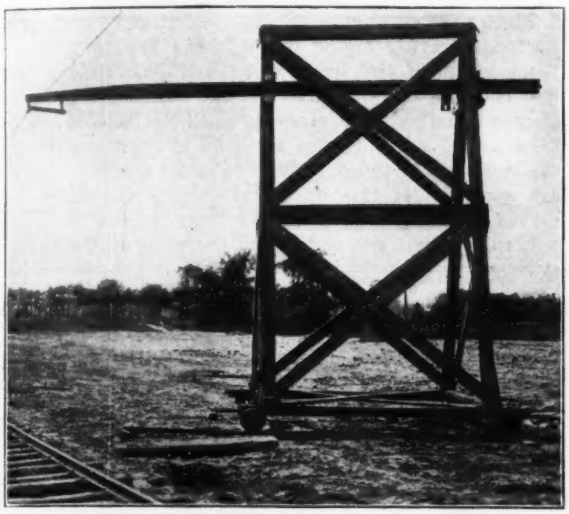
Throughout the line, the trolley wires are offset 7 ft. from the center line of the track, to permit the loading of dump cars and for clearance of the excavating



LOOKING ACROSS THE 15,000,000 YARD DUMP OF THE QUEENSTON-CHIPPAWA POWER CANAL

machines. On the dump, where the fill is moving from time to time, the trolleys are carried on portable frames, shown in the accompanying view. These timber frames, with outriggers for the trolley supports, are mounted on flanged wheels, which run on short sections of track, set up on the filled side of the tracks on which the dump trains run. As the fill progresses and the filling tracks need to be shifted, the portable frames are moved accordingly.

The railroad enters the trapezoidal shaped dump area at one corner, from which the dumping tracks fan out over the site. At first a trestle was built well out into the middle of the area and the fill started from it. On this trestle fixed trolley poles were used. In addition, the railway was continued around a hill at one side of the area, and end-dump spurs run out at intervals therefrom. Filling is then continued by shifting tracks from the center fill or the spurs, and side dumping. In this way a number of dumps are maintained sufficient to take care, without train interference, of all the spoil delivered.



PORTABLE TROLLEY FRAMES AT WHIRLPOOL FILL

At present about 24,000 cu.yd. of excavation—mixed rock and earth—is being delivered every 20-hour day. This requires about 300 trains per day of a maximum 10-car make-up. The cars are 16-yd. and 20-yd. capacity. The dry cut canal is nine miles long, and the two-mile dump spur takes off about six miles from the upper end of the canal.

The Queenston-Chippawa Canal is being built by force account under the direction of F. A. Gaby, chief engineer of the Hydro-electric Power Commission of Ontario, with H. G. Acres, hydraulic engineer of the commission, and J. B. Goodwin, works engineer, in immediate charge.

Cost of Holding Vessel in Port

An analysis of shipping costs made by the United States Shipping Board, says W. S. Meriwether of the board's information bureau, shows that the average daily cost of keeping a vessel in port exceeds $3000. The figures were made up for a 10,000-ton vessel. Because these port costs are so high, quicker turnaround of vessels is counted on to reduce cost of ocean carriage.

New Port and Shipping Statistics

DURING the war there was organized in the United States Shipping Board a branch termed the Port Facilities Commission, made up mainly of officers of the Army and Navy, with Maj. Gen. W. M. Black, U.S.A., as chairman, Rear Admiral H. H. Rousseau, U.S.N., vice-chairman, and Capt. F. T. Chambers, U.S.N., chief engineer. The commission has from time to time issued bulletins giving statistics of American ports, but it has collected a considerable quantity of such statistics which it has not been possible so far to have published. For the present, apparently, the commission will not be able to do very much active work, inasmuch as it has now been put entirely on an advisory basis, with the personnel reduced to the lowest degree. It is, however, willing and anxious to give consideration to any questions regarding port and harbor facilities in this country which may be directed to it. Meanwhile, there are available two documents, just published, which should be of considerable use to engineers interested in shipping.

These are the 68 pages of testimony in the hearings before the Committee on Merchant Marine and Fisheries in the House of Representatives, which includes the statements regarding the Shipping Board's interest in floating dry docks and a supplementary series of tabulations of shipping in the past generation. These are published as a part of the committee's inquiry into the operations of the United States Shipping Board, and should be available from the House of Representatives document room. The charts of shipping are entitled "Charts Showing Progressive Growth in Size of the World's Vessel Tonnage, 500 Tons Gross and Over, According to Classes of Tonnage, Length, Width, and Deep-Load Draft by Quinquennial Periods 1859 to 1918, and Analyses Thereof." In the charts are included graphic statistics of the coffee movement from Brazil to various parts of the states, forming one of a possible great number of similar analyses of various imports. There are also given the number and gross registered tonnage of all steamers afloat, total entrances of steamers in ports in this country, total number and length of dry-dock facilities, 1910-1917, gross registered tonnage of steamers afloat, distribution by states and commodities of agricultural products, distribution of textile manufactures and principal mining products. The remaining charts are devoted to the comparative technical statistics of war shipments. The second publication which is available is entitled "English Port Facilities," by Capt. F. T. Chambers. Captain Chambers made a trip to England during the war, and had exceptional facilities to gather full statistics of all of the English ports and harbors. The result is included in a large volume with a greater number of charts, maps, and details of English shipping terminal facilities than have ever been published before in this country.

Construction Corporation's Share of 1917 Taxes

Corporations engaged in construction paid income and excess-profit taxes during 1917 to the extent of $29,725,220, according to a compilation recently received by the Bureau of Internal Revenue. The total tax collected from corporations was $2,142,445,769. Of that amount 62% was paid by manufacturing corporations. Merchandising corporations paid 15% of the total. Mining corporations paid $212,365,019.

Light Bituminous Treatment for Macadam Roads

Thin Coatings Better Than Building Up Heavy Mats —Heavy Traffic Maintained at Moderate Costs—Tar Used

By Chester A. Hogentogler
Borough Engineer, Columbia, Penn.

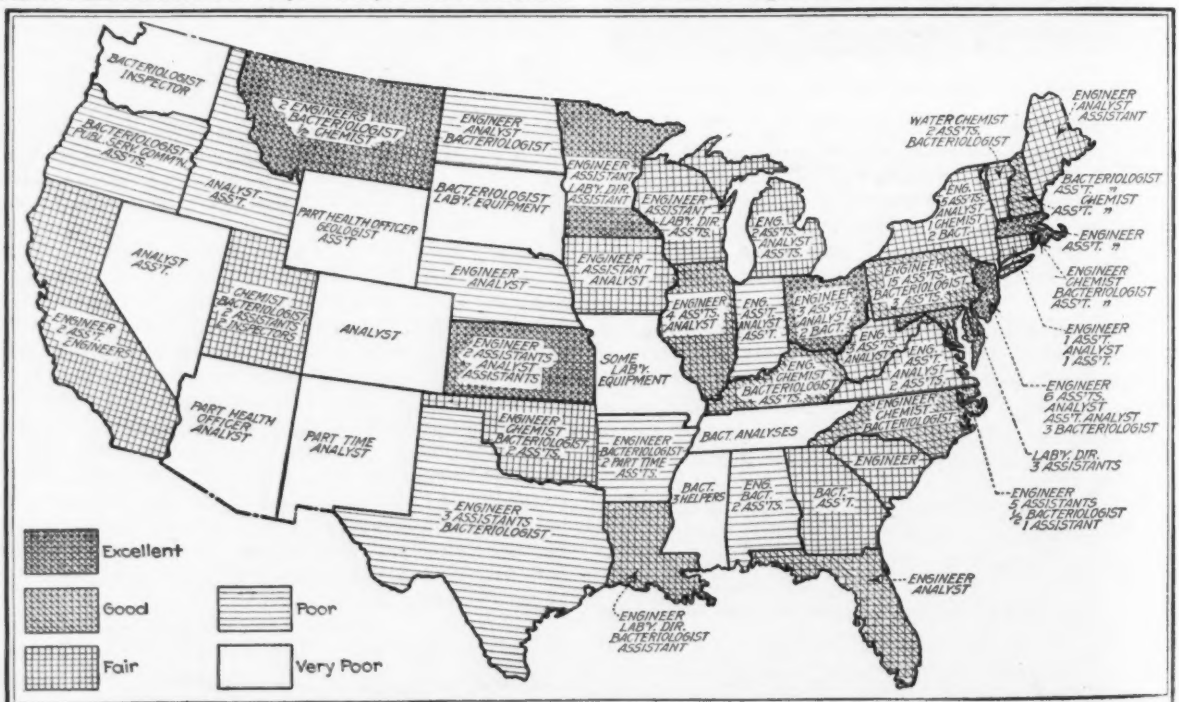
SUCCESS in the preservation of macadam roads at Columbia, Penn., has been attained by the application of light treatments of bituminous material of high penetration. Low-penetration materials having a tendency to build up heavy mats have not been found satisfactory or economical. The manner in which these treated roads have supported heavy traffic, with moderate maintenance charges, is of interest as showing how many of the advantages offered by higher-priced pavements can be obtained without excessive cost. Tar has been found to be preferable as a binding material in this type of work.

Generally speaking, treatments of this character are divided into three classes, according to the materials used and the results obtained. In the first class are those in which heavy bituminous materials with little or no penetrative power are applied, usually hot, and covered with a layer of stone chips or slag. The result is a heavy mat or carpet with little or no bond to the original macadam surface. In the second class are those treatments in which lightly penetrative materials are applied first to the original surface, and afterward the heavier binders are applied and covered with chips or slag. The result in this case is also a heavy mat or carpet with variable adhesion to the original surface. The third class consists of those treatments in which bituminous materials of highly penetrative, binding and hardening power are applied, usually cold, and covered with a light layer of sand to prevent tracking.

Since the first step in the disintegration of a macadam surface carrying motor traffic is the loosening up and forcing out of the small stone and dust binder from between the larger stones of the wearing course, the simplest method of preserving such surfaces is the application of a bituminous material of such quality that the bond will be tough enough to resist the stresses that are applied. If this dust and chip bond can be preserved, the large stones cannot become loose or pushed out, rutting will not occur, and the wear on the surface

Rating of State Sanitary Control of Public Water-Supplies

BASED on a rating scale having 1000 as perfect, the state control of water-supplies in the United States ranges from 970 points for Ohio and Michigan to 10 for Missouri. The rating, which was made by the United States Public Health Service, in 1919, shows seven states as "excellent," eight as "good," 15 as "fair," eight as "poor" and nine as "very poor." Details are given by the accompanying map. About two-thirds of the departments have one or more engineers, Pennsylvania leading with a chief engineer and 15 assistant engineers.



Figures Indicate Rating based on a possible 1000

Excellent		Good		Fair				Poor		Very Poor			
OHIO	970	FLA.	865	VT.	785	MICH.	710	ALA.	555	WASH.	340	WY.	110
MASS.	970	N.C.	855	CALIF.	775	OKLA.	710	ORE.	540	COLO.	260	MO.	10
KAN.	930	PENN.	850	TEX.	770	GA.	695	IND.	535	S.D.	250		
N.J.	910	LA.	850	CONN.	760	IOWA	660	NEB.	480	ARIZ.	225		
R.I.	910	KY.	835	VA.	760	UTAH	640	N.D.	470	N.M.	200		
MINN.	910	N.H.	835	MAINE	730	WIS.	630	ARK.	470	TENN.	160		
MONT	900	MD.	830	W.VA.	730	S.C.	615	NEV.	430	MISS.	130		
		ILL.	830	N.Y.	710			IDAHO	420				

will be dependent on the hardness and toughness of the larger stones of which it is composed.

The first two classes of treatment, involving the formation of a heavy mat on the original macadam, tend toward giving an uneven surface by cracking off in spots, where hard binders are used, and pushing and bunching when successive treatments of soft binders are used. Furthermore, the cost of these heavy carpets often warrants the construction of a more expensive type of surface. From observations covering a period of eight years, the writer has found the third class of treatment overcomes the objections referred to above.

Aside from the materials used in treatment, the character of the surface to be treated must be considered, if the best results are to be obtained. This is especially so with respect to the size of stones composing the wearing course. Upon this size depends, primarily, the success or failure of the treatment, and consequently the cost of maintenance. The Borough of Columbia has found that on streets where wearing courses are composed of stones less than 1½ in. in size, economy warrants resurfacing them with ballast ranging from 1½ to 3 in., in preference to attempting to maintain the original surface with bituminous materials. The extra expense of maintaining a surface composed of small stones is occasioned by the fact that after the first application a continuous breaking out in spots to a depth of about 1 in. results. These spots soon wear down to the foundation, or, if they are packed with bituminous material and stone, the cost becomes greater annually than the interest on the investment required to place a new surface composed of the larger sizes.

Consideration of the accompanying surface diagram shows the reason for this breaking out. The untreated macadam is a one-layer surface, and breaking begins

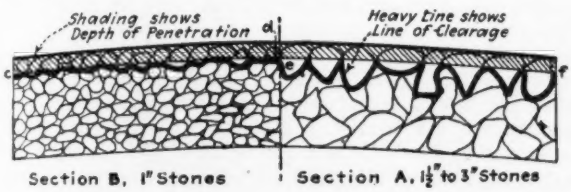


DIAGRAM SHOWS PLANE OF CLEAVAGE ON LARGE AND SMALL STONE SURFACINGS

at the top, where the stress is greatest. An application of bituminous binder transforms this single layer into a surface composed of two distinct layers, the top one of which is composed of bitumen, screenings and stone, and the bottom one of screenings and stone. Providing that a proper penetrating and binding material has been used, the weakest part of the original surface is along the plane between the two layers (shown on the diagram by the heavy black, irregular line), and it is along this plane that the top breaks away from the bottom, causing pot-holes, as noted above. The position of this plane of breaking is entirely dependent upon the size of the stones used. In order to overcome this, it is necessary that this plane of division be so far beneath the surface that the distributed unit stress at that point will be less than the adhesion.

Section B of the diagram shows that, in a surface composed of 1-in. stone and ¾-in. penetration the position of this breaking plane is about 1 in. from the top, designated by the line b-d. With 1½- to 3-in. stone and ¾-in. penetration this plane e-f is shown by Section A of the diagram to vary from 1¼ to 3 in. from the top. It follows that for the same thrust at the surface the unit stresses resulting along the division plane in the small stone surface will be about four times as great as that along the plane in the large stone surface. More than that, the mechanical bond furnished by the larger stones offers greater resistance to separation than that of the smaller, making the ratio far more than 4 to 1.

It has been observed that traction-engine lugs will break out sections of treated small stone surfaces, while no impression is made on those composed of large stones. While small stone surfaces one year after treatment are often full of holes, adjoining surfaces composed of larger stone, from the same quarry, treated at the same time with similar material, are practically free from such breaks.

Experience in Columbia

Since 1912 the Borough of Columbia has used various light and heavy materials, in an effort to preserve its macadam surfaces, and has finally adopted Tarvia-B covered with a light layer of sand, as the treatment which accomplishes most economically and effectively the required result. Before treatment the streets are resurfaced with large stone macadam. After proper seasoning the bituminous material is applied simply as a preservative or paint coat, with no attempt to build up a mat. The excess material is taken up by a thin layer of river sand.

As examples of the success of this treatment in Columbia, two streets carrying heavy traffic may be cited. The application of Tarvia-B was first made on N. 3rd St. in 1912, following the construction of a 6-in. macadam surface. The binder was applied by hand and spread by brooms at the rate of ¼ gal. per square yard, and covered with river sand at the rate of 1 cu.yd. to every 330 sq.yd. of surface. In 1913 a second application was made at the rate of 0.13 gal. per square yard, at a cost of 2c. Since then it has received annual treatments of tar and sand at the rate of 0.11 to 0.19 gal. at a total average cost of 2.3c. per square yard. This street carries the maximum traffic of a manufacturing town of 14,000 population, and, since 1914, has taken the foreign traffic of the Lincoln Highway. The street is very satisfactory as to appearance, cleanliness and suitableness for traffic.

Locust St., between 4th and 5th Sts., was resurfaced with limestone and coated with Tarvia-B and sand in 1913. The first application was made by hand at the rate of 0.27 gal. per square yard, and broomed. The cost was 4.6c. It was covered with river sand at the rate of 1 yd. to every 290 square yards. Since then it has received annual treatments at the rate of 0.15 gal., at a cost of 2.3c. per square yard. It carries the same traffic as N. 3rd Street.

From observation of coatings on over 600,000 sq.yd. of surface since 1912, on which the bituminous material was applied by means of gravity and pressure, horse-drawn and motor distributors, and by hand with brooms, the writer has found that the most satisfactory and protective coating can be had by sweeping the surface clean, applying the tar from a pouring pot, spreading it by push brooms and covering it with a light layer of sand, and immediately opening the street to traffic. By brooming the tar, a minimum quantity can be used, thus allowing none to stand in puddles or to

run down at the sides. This saving in cost of tar more than offsets the additional cost of spreading by hand over that of spreading by machine.

Sand forms a harder and tougher resisting surface than chips or slag and presents a cleaner, smoother and more finished appearance to the eye. Notwithstanding this smooth appearance, there have been less complaints of horses slipping on sanded surfaces than on those covered with slag. Upon close examination of this matter, it is found that the sanded surfaces are actually rougher after several months' wear. While other coverings often wear so smooth as to offer almost no foothold for horses, the grains of sand, instead of wearing smooth, break out, leaving a sandpaper finish which effectually prevents slipping and skidding.

At present there are about 130,000 sq.yd. of street surface in the borough under the preferred treatment and giving satisfactory results. The average first coatings were made at the rate of 0.25 gal. per square yard and subsequent coats at from 0.1 to 0.2 gal., with a cubic yard of sand covering 300 sq.yd. The total average cost of first treatment from 1912 to 1918 was 4c. per square yard and subsequent treatments cost 2c. per square yard. In some residential sections with light traffic, treatments were required only every other year.

The average cost for the first 100,000 sq.yd. treated in 1919 was 3c. per square yard. The average rate of application was 0.15 gal., with a minimum of slightly less than 0.1 gal. per square yard. On an average, a cubic yard of sand covered 290 sq.yd. of surface. The total average cost of hauling and labor was 0.6c. per square yard. The maximum yardage was covered June 20, when a foreman, two carts and 11 men coated 9775 sq.yd. in an eight-hour working day. The average yardage of the work done by this force was 6000 in nine hours.

The New City Zoning Ordinance of Alameda, California

Eight Classes of Use Districts and Four Building-Height Districts Established—Area of Lot That May Be Built On

By Charles E. Hewes
City Manager, Alameda, Calif.

WHAT is probably the most completely worked out and comprehensive zoning ordinance so far adopted in the United States was passed by the Alameda City Council on the recommendation of the city manager and advisory city-planning commission in February, 1919, and became effective Mar. 18 following. Alameda is a city of approximately 35,000 population, with about four miles of industrial waterfront along the north side of the city, and recreation beaches on the south side, the main portion of the city being a large island, with a second undeveloped area of several square miles of farm land, on Bay Farm Island, to the southeast.

After a year's careful study of the tendencies of growth in all parts of the city and the preparation of use-of-property and heights-of buildings maps, the city's consultant in city planning, Charles H. Cheney, held neighborhood meetings and conferences in each of the principal districts and centers of the city, some 40 conferences in all being held. At these an agreement was reached concerning what protections would be for the best interest of property owners in each neighborhood. These neighborhood recommendations were then combined in a general zoning plan, and the whole was put up for public hearing as the preliminary form for the zoning regulations. So well had the preliminary work of education been done, however, that there were practically no objections to the ordinance, either at this time or at the later hearings after it was introduced before the city council.

This ordinance is expected to stabilize property values, prevent the deterioration of residence districts, help business by requiring its concentration at established centers, and by making a definite place for industries to locate and invest where they will be safe from protest and interference.

It combines the best features, we believe, of the Los Angeles, St. Louis and New York ordinances, and is similar to the zone ordinance adopted in Palo Alto (population 6000) in August, 1918.

The ordinance applies to new building permits only, the existing buildings and uses of property not being affected even though they fall outside the respective zones proper for them.

Eight Classes of Use Districts Found Necessary

Eight classes of use districts were found to be the minimum that would cover our requirements. The use districts are as follows:

Class I. Residence: Single-family dwellings only, covering about two-thirds of the residence area of the city.

Class II. Residence: Any kind of dwellings, flats, dormitories, apartments, hotels without stores, covering about one-third of the city, in which flats and apartments were already established.

Class III. Business and Public Use: Ordinary, better-class retail business, trades and professions, including residences of Classes I and II. Two principal business centers of the city, on Webster St. and on Park St., each some six blocks long, were put into this class, with smaller business districts of Class V adjoining them.

Class IV. Business and Public Use: Schools, public and semi-public buildings, churches, playgrounds, greenhouses and nurseries and parks, including single-family dwellings. All such institutions throughout the city have been placed in small districts of this class, comprising only the size of the lot which they occupy.

Class V. Business and Public Use: All types of business use of Class III, plus public garages, dyeing and cleaning establishments, wholesale business, warehouses, oil-supply stations and any kind of residence, or public use of Classes I, II, III or IV. They comprise small areas adjoining the Class III centers, and also many little local business centers at cross-roads in residence sections.

Class VI. Business and Public Use: Hospitals, sanitariums, charitable institutions, and any kind of residence of Classes I and II. As yet no districcts of this class have been assigned. Any new institutions of this type will have to have a public hearing and secure approval of the neighborhood and amendment of the zoning plan, before locating.

Class VII. Industrial Districts: All ordinary, non-obnoxious factories, warehouses and industries, including any business use, but excluding new residences of any kind. A district one-half mile wide and about three miles long, along the north water front, was established,

where the present industries of the city are located. Another industrial district was also provided on Bay Farm Island, for future development. The first district is identical with the previous industrial zone established by ordinance a year ago, which, also, prohibited new dwellings from going in and blocking the growth of industry.

Class VIII. Industrial Districts: Obnoxious and odor-producing factories, including any business use, but excluding new residences of any kind. One district of this kind only has been established now, on the leeward side of the city, where the prevailing winds will blow smoke and odors away from the city, across the bay marshes to the eastward.

Building Height Limits Established

The ordinance also provides for protecting the various parts of the city from the dangers of overcrowding, and depreciation of property values by the building of scattered over-high structures. The following height districts were arranged to protect the existing tendencies of growth:

Two-and-a-half Story: All new buildings to be limited to a maximum of two stories and finished attic, not to exceed a total height of 35 ft. to the finished line of the attic floor above the curb. As over 99% of all the buildings in the city were found to be of this type, or less in height, the city felt justified in maintaining this tendency. This height limit was placed upon the residence districts of Class I.

Three-story: Not to exceed 40 ft. to the finished ceiling line of the third floor; established to cover the Webster St. business district and residence districts of Class II, for hotels, flats and dwellings.

Four-story: Not to exceed 50 ft. to the finished ceiling line of the fourth floor. One district of this kind only was established for the present, to cover the principal business center of Classes III and V on Park Street.

Eight-story: Not to exceed 90 ft. to the finished ceiling of the eighth story, to cover the industrial districts of Classes VII and VIII. This is perhaps a higher limit than necessary. The city's consultant advised four stories, which had been the limit in our previous industrial-zone ordinance of 1918. Some of the planning commission could not understand the need for any limits, and the compromise height of eight stories resulted.

Towers, tanks, chimneys, spires, etc., covering an area of not more than 15% of the lot, are allowed to be built up to any height.

Area Requirements to Insure Light and Air

In industrial districts of Classes VII and VIII, where windows are needed for light and air, a rear yard of not less than 5 ft. must be provided.

In business and public use districts of Classes III, IV, V and VI all yards and courts, where required for light and air, must not be less in dimensions than required for tenement houses in the California state tenement-house act.

In residence-use districts of Classes I and II, yards and courts, whatever use the building is put to, must be the same as for a dwelling in the California state dwelling-house act.

A special class of "home area districts" includes all Class I single-family dwelling districts and provides that no lot may hereafter be covered more than 50%. It was found that practically all of the dwellings in these districts now cover only from 20 to 25% of the lot, and that therefore this restriction would not be stringent.

I am glad to say that there are no "unrestricted districts" or unfinished portions of the zoning work in this ordinance, such as have been left in some of the larger cities, although it is less difficult in a small city to leave them in. Alameda, therefore, has complete control of the situation. However, new locations for industries, particularly adjoining railroad lines, and other changes of districts, can be brought about, by amending the ordinance and holding public hearings, in a very short time. No such changes, however, can hereafter be made without the neighborhood being consulted, and none of the city is left in uncertainty. We expect the ordinance to be amended from time to time to keep pace with the needs of the city as it grows.

With the zoning of the city settled upon, Alameda has a definite and exact basis on which to lay out a major-traffic street plan. The minor residential streets are determined by the zones established, and can be paved with less costly and narrower pavements, with more parking accordingly. The fire limits of the city can be rearranged to cover only business districts, and so no hardship is worked on other areas. A sound basis for mortgage loans has been established, thus stabilizing land values, and making a surer and easier foundation for city assessments and taxation.

Zoning is a fundamental move in city progress from which we anticipate a great deal of good in Alameda.

Holding Power of Track Spikes

Laboratory Tests Indicate Advantages of a Spike With Grooved Shank as Compared With Ordinary Drive Spike

COMPARATIVE tests on the holding power of two types of drive spikes indicate an advantage for a new design. The tests were made for the American Spike Co., New York, using a specially grooved shank over the ordinary cut spike. The former is the Sessler grip spike, shown in the accompanying drawing, while the latter is the standard chisel-point spike of the Pennsylvania Railroad, Western Lines, having a $\frac{5}{8}$-in. shank 6 in. long under the head. Screw spikes of the type used on the Delaware, Lackawanna & Western R. R. were included for comparison with the drive spikes. These tests were made at Columbia University, New York, by Albin H. Beyer and William J. Krefeld, in the laboratory of the department of civil engineering.

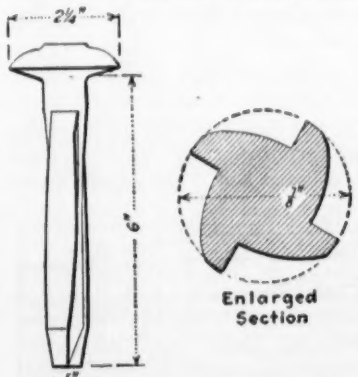


FIG. 1. NEW TRACK SPIKE HAS SPIRALLY GROOVED SHANK

Tests were made with both types of drive spikes driven into solid wood and into bored holes, the diameter of the hole being $\frac{1}{2}$ in. for the cut spike and $\frac{7}{16}$ in. for the grip spike. Taking an average of all the kinds of wood used and taking the hold of a cut spike

driven without a hole as 100%, the other spikes show as follows: Cut spikes in hole, 93.1%; grip spike, 129.3% without hole and 122.7% with hole; screw spike with hole, 172.9%. While these results indicate a slightly greater initial resistance for the spikes driven into solid wood, the report states that this increase is of doubtful value, as the efficiency and ultimate life of a spike in a tie depends more upon the range of elastic behavior of the wood fibers, provided the friction between these fibers and the spike is sufficient.

A cut spike driven into solid wood crushes and

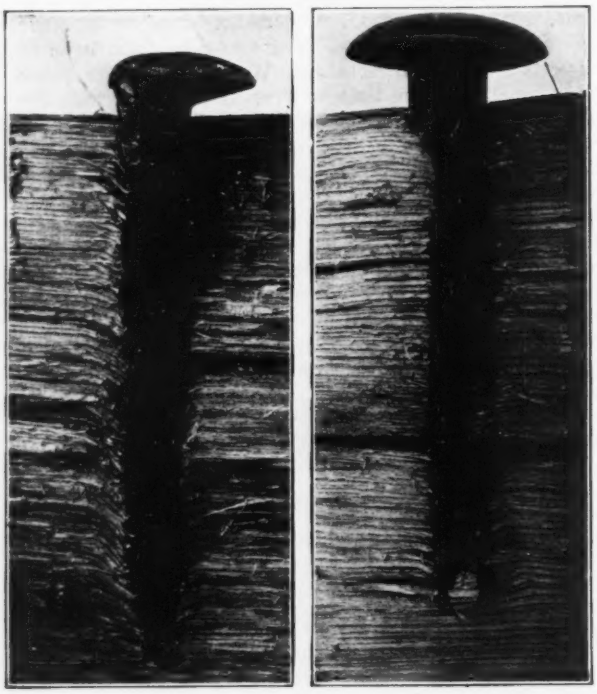


FIG. 2. DRIVE SECTIONS PRODUCED BY CUT AND GROOVED SHANK SPIKES USED IN TESTS

bunches the fibres over a wide area, due largely to the splitting and wedging action being confined to one plane. With the grip spike this splitting action appears to be less, due partly to the shape of the point,

AVERAGE HOLDING POWER OF SPIKES

	Cut Spike		Grip Spike		Screw Spike
	No Hole	½-in. Hole	No Hole	⅞-in.-Hole	in Hole
	lb.	lb.	lb.	lb.	lb.
Chestnut	5150	4908	7,180	6,100	9,100
Creosoted yellow pine	4850	4700	6,890	6,500	8,500
White oak	9020	8700	10,300	11,800	15,560
Douglas fir	4280	3539	5,200	4,600	7,170

but more particularly to the fact that the spike rotates in driving, its average turn being 63° in solid wood and 68° when driven in a bored hole. The report states

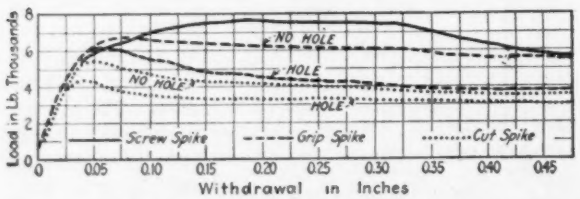


FIG. 3. COMPARISON OF PULLING TESTS OF SPIKES

that in this way the splitting and wedging action is not confined to one plane, and that the cumulative effect upon the wood fibers appears to be reduced. With both spikes the crushing and bunching of the wood fibers can be reduced materially by boring the hole. It may be noted that the effect on the wood de-

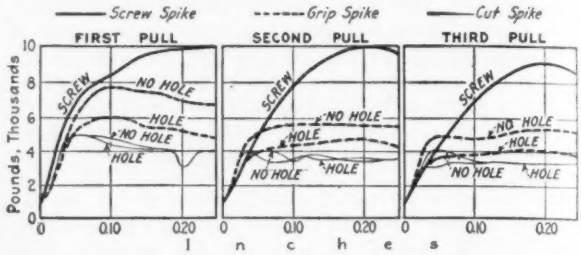


FIG. 4. COMPARISON OF RESULTS WITH REDRIVEN SPIKES

pends largely upon the efficiency of the operator, and that the report explains that these test spikes were driven by a man inexperienced in track work.

Sections of the drives of the ordinary cut spike and the grooved shank spike are shown in Fig. 2. The average results of the pulling tests are shown in the accompanying table and in Fig. 3, the latter representing tests in an untreated chestnut tie. Another set of tests was made with the spike pulled ¼ in. and then twice redriven and pulled, thus simulating the condition for track spikes which work loose and are driven home. Fig. 4 shows the results in chestnut ties. For the relative average elastic limits of withdrawal, taking the cut spike at 100% the report gives that of the grip spike as 129% and that of the screw spike as 90% for the elastic limit in bearing and 178% for the final yield point.

Unemployment Reduced by Societies' Bureau

The Engineering Societies' Employment Bureau's latest report to Engineering Council summarizes the bureau's activities for the ten months, Dec. 1, 1918-Sept. 30, 1919, in the following figures:

Men interviewed	17,083
Men registered	4,858
Men reported placed	1,000
Positions registered	1,988
Letters of application forwarded	15,691
Pieces of mail sent out	19,974
Expenditures	$10,601.19

It is explained in the report that the figure for the number of men reported placed is only approximate and, indeed, much lower than it should be, due to the great difficulty of getting reports from men after they have obtained positions. The majority of the positions registered, the report says, pay from $125 to $175 per month. Col. Arthur Woods, late head of the War Department Employment Service, commended the work of the bureau and said that the cost of operation as shown in the bureau's report was very low, considering the highly technical and professional character of the men served. Although the joint bureau arrangement in New York City has been discontinued, the Engineering Societies' Bureau continues to coöperate with the War Department, the Red Cross, the Young Men's Christian Association, the War Camp Community Service, the Knights of Columbus, and all college organizations, which refer to the bureau all engineering applicants and positions listed. The number of engineers visiting the bureau's office in New York ranges from 60 to 70 per day.

Industrial Conference Makes Preliminary Statement

Body Appointed by President Invites Criticism of Plan for Federal Tribunal To Adjust Industrial Disputes

A "PRELIMINARY statement," submitted with the object of promoting discussion and constructive criticism, was made public Dec. 29 by the President's Industrial Conference. That portion of the report dealing with the mechanism for carrying out its tentative plan for the adjustment of industrial differences by a National Tribunal and Regional Boards is reproduced, in full, below:

Introduction

The Industrial Conference, convened by the President in Washington on Dec. 1, issues this statement in the desire that certain tentative proposals be given considerate study by interested individuals and organizations throughout the country. It will reassemble on Jan. 12 and will then carefully consider any constructive criticisms that may be submitted to it.

The Conference does not deem it useful at this time to enter upon a discussion of the causes of industrial unrest. It believes rather that its most important immediate contribution is the suggestion of practical measures which will serve to avert or postpone industrial conflicts.

In confining itself to the proposal of machinery for the adjustment of disputes, the Conference is far from wishing to exaggerate the importance of the mechanical as contrasted with the human elements in the situation. Our modern industrial organization, if it is not to become a failure, must yield to the individual a larger satisfaction with life. It makes possible a greater production of material things. But we have grown so accustomed to its complexity that we are in danger of forgetting that men are today more dependent on each other than ever before. The spirit of human fellowship and responsibility was easier to maintain when two or three worked side by side and saw the completed product pass from their hands. Yet their co-operation was actually less necessary because each by himself was more nearly capable, if circumstances demanded, to meet the needs of life. Today we have a complex interweaving of vital interests. But we have as yet failed to adjust our human relations to the facts of our economic interdependence. The process toward adjustment, though slow, nevertheless goes on. The right relationship between employer and employee in large industries can only be promoted by the deliberate organization of that relationship. Not only must the theory that labor is a commodity be abandoned, but the concept of leadership must be substituted for that of mastership. New machinery of democratic representation may be erected to suit the conditions of present industry and restore a measure of personal contact and a sense of responsibility between employer and employee. The more recent development of such machinery with the co-operation of organized labor is a hopeful sign. But back of any machinery must be the power which moves it. Human fellowship in industry may be either an empty phrase or a living fact. There is no magic formula. It can be a fact only if there is continuous and sincere effort for mutual understanding and an unfailing recognition that there is a community of interest between employer and employee.

Pending the growth of better relationships between employers and employees, the practical approach to the problem is to devise a method of preventing or retarding conflicts by providing machinery for the adjustment of differences. The Conference believes that it is possible to set up a more effective series of tribunals for the adjustment of disputes than at present exists. To be successful, such tribunals must be so organized as to operate promptly as well as impartially. There must be full participation by employers and employees. There must be representation of the public to safeguard the public interest. The machinery should not be used to promote unfairly the interests of organizations, either of labor or of capital. The plain fact is that the public has long been uneasy about the power of great employers; it is becoming uneasy about the power of great labor organizations. The community must be assured against domination by either. On the other hand, there must be equal assurance that such machinery will not be used to discriminate against organizations of employees or of employers. Both should be protected. The right of association on either side should not be affected or denied as a result of the erection of such tribunals.

The plan which follows does not propose to do away with the ultimate right to strike, to discharge, or to maintain the closed or the open shop. It is designed to bring about a frank meeting of the interested parties and cool and calm consideration of the questions involved, in association with other persons familiar with the industry.

The plan is national in scope and operation, yet it is decentralized. It is different from anything in operation elsewhere. It is based upon American experience and is designed to meet American conditions. To facilitate discussion, the plan submitted, while entirely tentative, is expressed in positive form and definite as to most details.

Plan for Boards of Inquiry and Adjustment

There shall be established a National Industrial Tribunal, and Regional Boards of Inquiry and Adjustment.

The National Industrial Tribunal shall have its headquarters in Washington, and shall be composed of nine members chosen by the President and confirmed by the Senate. Three shall represent the employers of the country and shall be appointed upon nomination of the Secretary of Commerce. Three shall represent employees and shall be appointed upon nomination of the Secretary of Labor. Three shall be representatives of the public interest. Not more than five of the members shall be of the same political party.

The tribunal shall be, in general, a board of appeal. Its determinations on disputes coming to it upon an appeal shall be by unanimous vote. In case it is unable to reach a determination, it shall make and publish majority and minority reports which shall be matters of public record.

The United States shall be divided into a specified number of industrial regions. The Conference suggests twelve regions with boundaries similar to those established under the Federal Reserve system, with such modifications as the industrial situation may make desirable.

In each region the President shall appoint a regional chairman. He shall be a representative of the public interest, shall be appointed for a term of three years and be eligible for reappointment.

Whenever in any industrial region, because of the multiplicity of disputes, prompt action by the Regional Board is impossible, or where the situation makes it desirable, the National Industrial Tribunal may in its discretion choose one or more vice-chairmen and provide for the establishment under their chairmanship of additional regional boards.

Panels of employers and employees for each region shall be prepared by the Secretary of Commerce and the Secretary of Labor, respectively, after conference with the employers and employees, respectively, of the regions. The panels shall be approved by the President.

At least twenty days before their submission to the President provisional lists for the panels in each region shall be published in such region.

The panels of employers shall be classified by industries, the panels of employees shall be classified by industries and subclassified by crafts. The names of employers and employees selected shall be at first entered on their respective panels in an order determined by lot.

The selection from the panels for service upon the Regional Boards shall be made in rotation by the regional chairman; after service the name of the one so chosen shall be transferred to the foot of his panel.

Whenever a dispute arises in a plant or group of plants which is not settled by agreement of the parties or by existing machinery, the chairman may on his motion, unless disapproved by the National Industrial Tribunal, and shall at the request of the Secretary of Commerce or the Secretary of Labor or the National Industrial Tribunal, request each side concerned in such dispute to submit it for adjustment to a Regional Board of Adjustment. To this end each side shall, if willing to make such submission, select within not less than two nor more than seven days, at the discretion of the chairman, a representative. Such selection shall be made in accordance with the rules and regulations to be laid down by the National Industrial Tribunal for the purpose of insuring free and prompt choice of the representatives.

When both sides shall have selected their representatives the chairman shall take from the top of the panels for the industry concerned, or in the case of employees for the craft or crafts concerned, names of employers and employees, respectively. The representatives selected by the two sides shall be entitled to a specified number of peremptory challenges of the names so taken from their respective panels. When two unchallenged names of employers and employees shall have been selected in this manner, they, with the chairman and the representatives selected by the two sides, shall constitute a Regional Board of Adjustment.

The appointment of representatives of both sides shall constitute an agreement to submit the issue for adjustment and further shall constitute an agreement by both sides that they will continue, or re-establish and continue, the status that existed at the time the dispute arose.

The Board of Adjustment so constituted shall proceed at once to hear the two sides for the purpose of reaching a determination. Such determination must be by unanimous vote. In case the board is unable to reach a determination the question shall, unless referred to an umpire, as later provided, pass upon appeal to the National Industrial Tribunal.

Regional Boards of Inquiry

If either side to the dispute fails, within the period fixed by the chairman, to select its representative, the chairman shall proceed to organize a Regional Board of Inquiry. Such Regional Board of Inquiry shall consist of the regional chairman, two employers selected in the manner specified from the employers' panel, and two employees selected in like manner from the employees' panel and of the representative of either side that may have selected a representative and agreed to submit the dispute to the board. If neither side shall select a representative within the time fixed by the chairman, the Board of Inquiry shall consist of the chairman and the four panel members only.

Upon the selection of a representative, within the specified time, the side concerned shall be entitled to the specified number of peremptory challenges as provided above. The representative shall have the right to sit on the Board of Inquiry and to take full part as a member of such board in the proceedings thereof.

The Board of Inquiry as so constituted shall proceed to investigate the dispute and make and publish a report, or majority and minority reports, of the conclusions reached, within five days after the close of its hearings and within not more than thirty days from the date of issue of the original request by the chairman to the two sides to the dispute, unless extended on unanimous request of the board or the National Industrial Tribunal. It shall transmit copies of this report or reports to the Secretaries of Commerce and of Labor, respectively, and to the National Industrial Tribunal, where they shall be matters of public record.

At any time during the progress of the inquiry at which both sides shall have selected representatives and agreed to submit the dispute for adjustment, the Board of Inquiry shall become a Board of Adjustment by the admission to membership on the board of such representatives. The side or sides which appoint representatives after the date fixed in the original request of the chairman shall, because of its delay, suffer a reduction in the number of peremptory challenges to which it otherwise would have been entitled.

The Board of Adjustment so constituted shall proceed to the determination of the dispute as though it had been organized within the period originally fixed by the chairman.

When a Regional Board of Adjustment is unable to reach a unanimous determination it may by unanimous vote select an umpire and refer the dispute to him with the provision that his determination shall be final and shall have the same force and effect as a unanimous determination of such Regional Board.

Whenever the questions involved in a dispute extend beyond the boundaries of a single region, the regions to which the dispute extends shall, for the purpose of such dispute, be combined by order of the National Industrial Tribunal, which shall designate the chairman of one of the regions concerned to act as chairman in connection with the dispute in question.

Two employer members and two employee members shall be chosen from the combined panels of the regions involved in the dispute under rules and regulations to be established by the National Industrial Tribunal. The members representing the two sides to the dispute shall be chosen as in the case of a dispute in a single region.

A Regional Board of Inquiry or of Adjustment constituted for a dispute extending beyond the boundaries of a single region shall have the same rights and powers conferred upon a Regional Board for a single region.

Effect of Decision—Whenever an agreement is reached by the parties to a dispute or a determination is announced by a Regional Board of Adjustment, or by an Umpire, or by the National Industrial Tribunal, the agreement or determination shall have the full force and effect of a trade agreement which the parties to the dispute are bound to carry out.

General Provisions

In connection with their task of inquiry and adjustment, the Regional Boards and the National Tribunal shall have the right to subpœna witnesses, to examine them under oath, to require the production of books and papers pertinent to the inquiry, and their assistance in all proper ways to enable the boards to ascertain the facts in reference to the causes of the dispute and the basis of a fair adjustment. Provision shall be made by law for the protection of witnesses and to prevent the misuse of any information so obtained.

All members of the tribunal and boards heretofore described, including the chairman and vice-chairman, shall be entitled to vote.

The President shall have the power of removal of the members of the tribunal and boards.

In the presentation of evidence to the tribunal and the boards each side shall have the right to present its position through representatives of its own choosing.

The Secretary of Commerce and the Secretary of Labor in making nominations for the National Industrial Tribunal and in preparing and revising the regional panels of employers and employees shall from time to time develop suitable systems to insure their selections being truly representative.

The National Industrial Tribunal, the Regional Boards of Adjustment, and the Umpires shall in each of their determinations specify the minimum period during which such determinations shall be effective and binding. In case of emergency a Regional Adjustment Board or the National Industrial Tribunal may, after hearing both sides, alter its determination by abridging or extending the period specified.

The terms of office of members of the National Industrial Tribunal shall be six years; at the outset three members, including one from each group, shall be appointed for a term of two years, three members for a term of four years, and three members for a term of six years; thereafter three members, one from each group, shall retire at the end of each period of two years. Members shall be eligible for reappointment.

The regional panels provided for hereinbefore shall be revised annually by the Secretaries of Commerce and of

Labor, respectively, in conference with the employers and employees, respectively, of each region.

Relation of Boards to Existing Machinery for Conciliation and Adjustment — The establishment of the National Industrial Tribunal and the Regional Boards described shall not affect existing machinery of conciliation, adjustment, and arbitration established under the Federal Government, under the governments of the several states and territories or subdivisions thereof, or under mutual agreements of employers and employees.

Any industrial agreement made between employers and employees may, by consent of the parties, be filed with the National Industrial Tribunal. Such filing shall constitute agreement by the parties that in the event of a dispute they will maintain the status existing at the time the dispute originated until a final determination, and that any dispute not adjusted by means of the machinery provided through the agreement shall pass on appeal to the National Industrial Tribunal for determination, as in the case of a dispute submitted on appeal from a Regional Board.

The report concludes with the declaration of policy that the interruption of essential public utilities is intolerable and that Government employees concerned with the administration of justice or the public safety should not be permitted to join organizations which authorize the use of the strike.

The report is signed by the following:

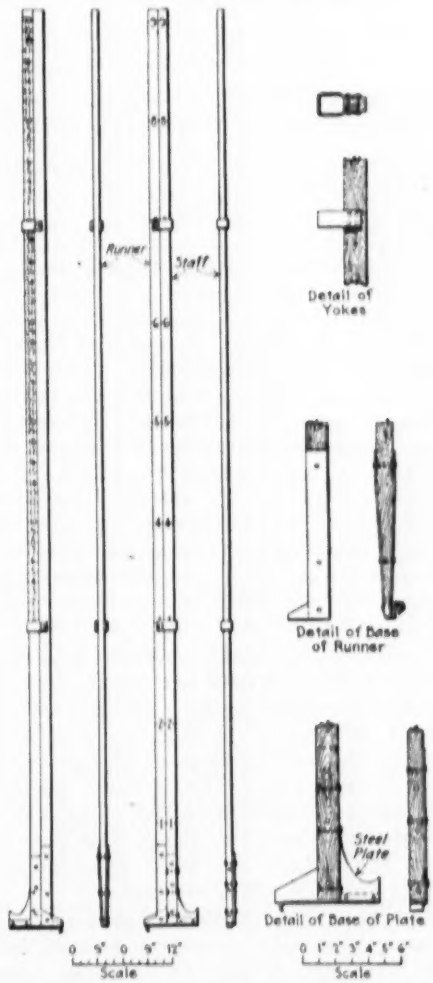
W. B. WILSON, *Chairman*	HENRY M. ROBINSON
	JULIUS ROSENWALD
HERBERT HOOVER, *Vice Chairman*	OSCAR S. STRAUS
	HENRY C. STUART
MARTIN H. GLYNN	F. W. TAUSSIG
THOMAS W. GREGORY	WILLIAM O. THOMPSON
RICHARD HOOKER	HENRY J. WATERS
STANLEY KING	GEORGE W. WICKERSHAM
SAMUEL W. McCALL	OWEN D. YOUNG

Unique Rod Made for Canal Soundings and Stream Measurements

A COMBINATION rod, the chief function of which is to take soundings in irrigation canals, but which serves various other uses—including cutting grass and moss, or removing trash from headings, bridge piers, or trash racks—is a development of years of use of many devices by W. G. Steward, formerly assistant engineer, United States Reclamation Service, Boise, Idaho, and now associate professor of agricultural engineering at the University of Idaho, Moscow. Mr. Steward recommends that the pole, if made of properly selected straight-grained wood, can be used for vaulting narrow canals, for laying off sections at a station, and it may assist materially in taking stream measurements. Where close work is not required, the pole has been used as an ordinary level rod.

This rod is 9 ft. in length and fitted with a runner much the same as an ordinary level rod. The bottom of the staff is fitted with a foot plate, one end of which is curved under to hold the rod to the bottom of the section, where the water is deep and swift and the bottom is of hard, smooth material like concrete or rock. The base of the staff is made large, so as to get more nearly the mean elevation of the surface of the stream bed. Attached to the foot plate and the bottom of the staff is a curved, sharpened, steel plate which serves as a grass hook. The rod is graduated in feet on one side, the obverse being graduated in tenths, the zero being set at the top of the two yokes attached to the runner and set at elevations on the rod of 3 and 7 ft., respectively.

When soundings are taken, the bottom of the staff is allowed to rest on the bottom of the section of the canal, the runner being elevated until the base skims the water. Soundings 2 ft. or less may be read from



DETAILS OF COMBINATION SOUNDING ROD

the top of either the upper or lower yoke. When the water is over 4 ft. deep any reading on the upper 2 ft. is added to 4 ft. Where the water is over 6 ft. deep, 3 ft. is added to the figures opposite the base of the runner.

Buildings Prohibited Where No Sewers

Under an ordinance passed by the City Council of Cleveland, Ohio, in November, 1919, the issuance of building permits on streets not provided with sewers is prohibited. There is a proviso, however, that the Commissioner of Buildings may issue such permits on receipt of a written statement from the Commissioner of Engineering that there is a prospect of sewerage facilities being provided within a reasonable time. A further proviso is to the effect that in exceptional cases a permit may be issued on the strength of a written communication from the Commissioner of Health that such action "will not jeopardize the public health and welfare because of the use to which the building may be put."

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Believes A. A. E. Will Not Support National Societies' Plan for Comprehensive Body

Sir—The report of the Joint Conference Committee of the four national societies, outlining a plan for a comprehensive national body, given on p. 835, and your editorial upon the same subject found on p. 846 of the Nov. 13-Nov. 20 issue, appear to me to overlook some very fundamental considerations.

For many years progressive members of the national technical societies preached the necessity for attending to the economic side of engineering. They tried many times to get something started similar to the plan now advocated. The younger engineers looked on with hope and expectation. The aristocracy of long years of experience set up by these societies through their high requirements for membership was accepted as a good thing. The thought was that these men of great technical ability would naturally be altruistic and of broad enough vision to see the human problems of the whole engineering field and provide the machinery for coping with them.

But those societies failed to see their opportunity and that duty. I believe I voice the attitude of thousands of the younger engineers when I say that we are skeptical of the old technical societies ever being capable of representing the whole profession of engineering, and particularly the interests of the younger engineers and those in less responsible positions. The plan of the Joint Conference Committee should have been laid out ten years ago and put into effect not later than five years ago. *Their opportunity is gone.*

Some of those who saw the need gave up the idea of ever getting the technical societies to take up that work. They gathered, and formed the American Association of Engineers as late as 1915, and this association is all that the Joint Conference Committee would have the technical societies become.

The early days of the new organization were overcast with doubt and misunderstanding. The ever-increasing stress of the economic conditions blinded many to the right course, and there were concerted attempts to make the association "a collective bargaining union." However strong those attempts may have been, A. A. E. never succumbed to them. Under the guidance of a few big engineers the structure and principles of this association became well founded upon professional ethics.

To-day A. A. E. is larger than any of the technical societies, and its rate of growth promises that within two years it will be larger than the combined national technical societies. It is thoroughly democratic, and its requirements for membership have been made low enough to make every professional technical man eligible and yet high enough to keep the nonprofessional man out.

Its structure is well designed to handle economic problems. The country is divided geographically into clubs, chapters and districts having complete jurisdiction over local problems not affecting more than their own localities, but which must coördinate their work through the national headquarters in all matters common to more than one locality. Then, in order to obtain direct information and concerted action in any branch of engineering, sections and departments are being formed. For instance, the New York Central Railroad Section is a part of the Railroad Department. Sections and departments do not have the same functions as clubs, chapters and districts, but are standing committees of a special character.

This association has done more for engineers in its four years of existence than all the technical societies together. A large percentage of its members are also members of national technical societies.

Now, does the Joint Conference Committee of the founder societies expect the members of A. A. E. to be so ungrateful for what the association has done as to throw it over and join a new combination? Would that be ethical? Certainly not. Does it not seem that the ethical procedure for the technical societies now is to acknowledge their shortcomings and give the new association their hearty support? The least they should do is not to compete with it.

The technical societies have done well for what they were designed, but how can anyone expect this proposed new combination to be a success built upon societies whose character and constitutions are not fitted for dealing with economic problems? The Bible teaches and history has proved, "No man putteth new wine into old bottles; else the new wine doth burst the bottles, and the wine is spilled, and the bottles will be marred; but new wine must be put into new bottles." (Mark II, 22).

J. HOLLOWAY MORGAN,
Certified Member, American Association of Engineers,
Washington, D. C.

Mr. Baker's Railroad Plan

Sir—Mr. Baker's article on the "Railway Problem" has exceptional merit. Very little that is written on this subject is worth reading, as apologists seem to control all publicity. The road to railroad bankruptcy has been a long one, and many gay buccaneers have ridden the investing public "high, wide and weary."

There is one book that will inform all engineers how the patient became so sick—Henry Clews' "Twenty-eight Years in Wall Street." This book contains the early history of the case. Read all about the mess that Uncle Dan'l and all of his kind have left us to clean up.

Section V of Mr. Baker's article, "The Danger of Too Centralized Control," deals with one of the most important phases of this question, and the present centralization is causing the collapse of the Interstate Commerce Commission by sheer weight of unfinished and "unknowable" business.

The railroad systems of this country are divided into two general areas—lines east and lines west of Chicago, St. Louis and the Mississippi River. If the Interstate Commerce Commission were divided into two equal parts we might hope for some constructive suggestions from it—the eastern division of the I. C. C., to have its headquarters in Washington, and the western division to have its headquarters in Kansas City.

The railroads to all practical intents and purposes are all one. The day of railroad competition is

over; "the eggs are scrambled," and there is no use in trying to bring back past conditions. The solution offered of public corporations is apparently workable, but of course every plan will be discredited as much as possible which does not originate with Uncle Dan'l's nephews. Mr. Baker's article suffers by condensation. The topic and point of view are worthy of much ampler treatment and elucidation. If it were in book form, the number of public corporations could be outlined, etc.

Some years ago a prominent London financier said that he had no interest in an American railroad until it had been in bankruptcy. Let us all hope that *finis* has been written to the long, sordid chapter from the Erie to the New Haven. FRANK W. HARRIS.

Olympia, Wash.

The Comedy of an Error

Sir—The publishers and authors of "Field Engineering" thank Antonio Llano for discovering and reporting to them some months previously the error noted in *Engineering News-Record* of Nov. 27-Dec. 4, 1919, p. 962. While the error is strictly typographical, it is none the less serious. The mistake occurred in the first edition of "Searles" and extends through the fifty-ninth thousand. In September, 1919, the writer directed that the plate be corrected.

It is the writer's desire to have all text and reference books with which he has to deal free from error. Errors in his own works are immediately corrected in the plates, whenever found or reported, and when he finds errors in other books he notifies the authors or publishers. HOWARD CHAPIN IVES.

Worcester, Mass., Polytechnic Institute.

[It is an interesting subject for speculation whether the error in question would not have been corrected many years ago if all engineers followed the commendable example of Mr. Llano and of Professor Ives in notifying authors and publishers of errors in— The editor had got this far in his comment when the following letter came to his desk:—EDITOR.]

Sir—Twenty-five or twenty-six years ago the misprint in Searles' "Field Engineering," giving the log versed sine of 87°33 as 9.881026 instead of 9.981026, as you noted last week, caused an amusing and exasperating occurrence on the E. & A. division of the Pennsylvania Co. At that time the E. M. W. corps (the writer transitman) were re-running and putting spirals on a main-line curve just west of Greenville, Penn., a curve about a thousand feet or so long, a job that should take about a half day. We got the curve "dope," set the point of spiral curve and point of compound curve at each end, then staked out the middle or circular part of the curve. The angles closed O.K. but the chaining would not check—some 3 ft. out, as I recall it.

Two of us had "figured" the curve, so we jumped on the chainmen, and sat in the shade while they were finding their "bust." They reported the chaining O.K. So Buddy and I refigured the curve. *All O.K.* Then we reasoned with the chainmen, without gloves, and Buddy and I took the chain to show the boys how a curve should be chained and to be a lasting example to them of how to find material errors in chaining. Their chaining proved to be right, and the corps spent the rest of that day first checking the calculations, then checking the chaining. These simply would not agree, so we took the late train back to headquarters. There the assistant engineer, a martinet, wanted to know whether that Greenville curve was staked. "No, sir." "Well, you are taking too much time for it." "Be sure to finish it in the morning and get in at noon." "Yes, sir."

I spent that evening checking over the calculations from every point, still finding them right. I went out the next day determined to find the "bull" in the field-work. All day it was the same old story, check calculation, check field work, till Buddy and I concluded we had gone crazy.

That night the assistant engineer "blew up" and we all certainly got ——. When he stopped for breath I stated the case to him, and decided to get out. It was not safe around there.

The morning of the third day, behold the corps, and the assistant engineer, at work on the curve, the assistant engineer being given all the rope he wanted and directing the whole job minutely. Still no check. Did we work hard all day? We did.

Going home in the train that night, as almost the last point of attack, I suggested to the assistant engineer that the tables of logs in Searles *were wrong*. He had about used up all his explosive material, but I got some slight reaction with that remark, so I went on into another car. There I took out "Searles" and had a general look at each log we had used. When I came to the log vers of 87°33 (one of our angles) Bingo! The first figure of the mantissa had been running 9-9-9; then for 87°33 it was an *8*; then followed 9-9-9. *The mystery was solved.* The calculations and field work checked. At that time (1893) I notified the publishers of "Searles" of the error, so Antonio Llano will not get any quick action.

It is only fair to say that it is a billion to one shot that this is the only misprint in the Searles log tables. I would stake my life on their accuracy any day if necessary, after thirty years of use.

New Castle, Penn. G. B. ZAHNISER.

[That publishers are more alert now than they were a quarter century ago is indicated by Professor Ives' statement that no time was lost in correcting the error in the plates. It is still an interesting subject for speculation how many times the error in question was discovered since the first edition of "Searles" was published, and what percentage of those who found it took steps to have it corrected.—EDITOR.]

Why Not Engineers on Industrial Committee?

Sir—The President has appointed a new committee whose duties are to attack the cost of living, and in the specific instance of industrial disputes to suggest solutions. This is a great work, and one which should be well done, for it is difficult to overestimate its potential good.

Comments by authorities on the composition of this committee have, as far as noted by the writer, been quite favorable. The many sides of the public mind are presumably well represented.

But are the best interests of the country well cared for when out of so small a group at least eight are lawyers? Why not more engineers, the men who build and operate the railroads, steamship lines and the physical cities and are the "go betweens" for the restless employee and the equally disturbed employer? True, the vice-chairman, Mr. Hoover, is an engineer, but the profession has many men his equal, and the writer

doubts that the best interests of the country are ever served in times of stress by the legal mind, which is not progressive and must have, for a crutch, a precedent upon which to function.

W. M. BUTTS,
Wendell M. Butts & Company, Civil and Mechanical Engineers.
San Francisco, Cal.

On the Alliance of the A. S. M. E. With the Industrial Conference

Sir—Your reference in your Oct. 23 issue to the American Society of Mechanical Engineers' alliance with the Industrial Conference Board was read with a great deal of interest by the writer, and I heartily agree with your point of view, which takes the same position as that of Morris Llewellyn Cooke in this matter.

The American Society of Mechanical Engineers should not be anti-labor or anti-capital, but should serve society as a whole, the public, as well as capital and labor. We should seek to be a balance wheel in these matters. Therefore, if we do not become entangled by alliances with either side we are in a much better position to serve the community as a whole. When I say the "community as a whole" I mean both capital and labor and the public.

As a member of the American Society of Mechanical Engineers I have taken this view, and also sent in my protest against our membership in the National Industrial Conference Board.

Your attitude regarding other societies aligning themselves with the Chamber of Commerce of the United States, etc., are well taken.

C. W. KOINER,
General Manager, Municipal Lighting Department, City of Pasadena.
Pasadena, Cal.

Drainage Works Maintenance in Minnesota

Sir—Your editorial on "Maintenance of Land Drainage Systems" (Oct. 16, 1919, p. 718), touches on a subject of vital concern to all drainage officials, and, it is hoped, will elicit a wide discussion.

Minnesota enacted in 1905 the first law outlining proceedings for the construction of drainage ditches within the state. This statute included a very general reference to the subject of repair and maintenance of drainage structures, by making it the duty of the boards of county commissioners to keep in repair all drainage improvements within their respective counties, and outlined a method of procedure to be followed in assessing and collecting the costs of doing the work.

The section of the law relating to repairs has been amended at every session of the legislature but one since its enactment, and I believe an honest effort has been made to seek out an efficient way of keeping public drainage ditches within the state in proper repair. The writer believes, however, that there is yet much to be accomplished along this line.

The causes which lead to the necessity of repairing drainage ditches are nearly always the caving-in of banks, the placing of obstructions in the ditch by careless and thoughtless settlers to afford temporary crossings or watering places for stock, the falling in of trees, etc. If funds were provided and it were made someone's duty to take immediate action to remedy these defects before the far-reaching effects caused by the lodging of silt and débris behind such obstructions had made necessary a formidable and expensive repair job, much expense and inconvenience could be saved the taxpayer.

The difficulty with placing the work of keeping ditches in repair with the county boards is obvious. It becomes no one's special duty to look after the smaller obstructions and defects before they have been the cause of sufficient mischief to cause some one individual or a number of individuals to demand action from the board. By the time the board has examined into the matters complained of and has authorized repairs, the drainage ditch in question has probably been so badly obstructed that to put it in its original condition will cost from 25% to 75% of its original cost.

The Minnesota legislature of 1917 authorized the boards of county commissioners of counties wherein drainage ditches costing in the aggregate $50,000 or more had been constructed to appoint a county ditch inspector (no qualifications) "whose duty it shall be to travel over the line of all such county and judicial ditches . . . . at least twice each season and inspect the same, observe . . . . what repairs . . . . may be necessary or proper, and immediately thereafter he shall make a full report in writing to the county board of his work, together with the estimate of the cost thereof," etc. It is then made the duty of the county board to act on the county ditch inspector's report at the "first meeting of the board following the filing of said report."

While providing for the appointment of an inspector may be a step forward, the effects of this provision will be far from hitting the vulnerable point—namely, securing immediate action at any time it might be found necessary and providing a fund, always available, from which to pay for minor emergency repairs. The removing of a load of hay placed intentionally or accidentally in an open ditch should not be made to await the filing of an inspector's report and a further delay for action on the report by the county board at its next following meeting. Neither should the crumbling of a bulkhead or the temporary obstruction of a costly underground tile drain be allowed to cumulate damages for a period of from one to five weeks awaiting favorable action and authority to repair from the county board. The old adage, "A stitch in time saves nine," can be no more forcibly demonstrated than in the immediate removal of obstruction from drainage ditches.

To provide for such a method of repairing drainage ditches the writer suggests:

1. The appointment of a qualified drainage engineer in each county of the state where drainage construction is a considerable factor of development, whose duty it shall be to supervise the repair and maintenance of drainage construction.

2. Authorizing the levying of a small annual tax—call it a sinking fund—upon all lands benefited by drainage, to meet the cost of keeping the systems in repair so that there will be funds available at all times.

3. Giving authority to the ditch inspector to expend for emergency repairs a sum not to exceed a certain amount for each such emergency job. Jobs requiring expenditures in excess of such stipulated amounts to be done only at the orders and by the authority given by the board of county commissioners.

E. V. WILLARD,
State Commissioner of Drainage and Waters.
Saint Paul, Minn.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Rod Readings in Tunnel Speeded Up By Can-and-Candle Device

A SIMPLE device used by the San Joaquin Light and Power Co. on the work under way at Auberry, Cal., has saved time in making direct readings on a rod in tunnels or where artificial light has to be used. Its purpose is to illuminate the figures on the rod at any height, by means of which the rodman can speedily change from one height to another.

The device consists of a gallon can with two holes made in its sides near the bottom large enough to thrust the rod through, the target having first been removed. The can is put on the rod with its bottom in a vertical plane, leaving the face of the rod visible through the open top of the can. The top is not entirely cut out of the can, just enough being left at one side to shield a candle fastened there. Thus, the candle illuminates the figures without shining directly toward the observer. The can is raised and lowered by means of a string passing from the can to the top of the rod and back down to a convenient height. In lieu of a pulley at the top of the rod the string is passed over the thumbscrew which is ordinarily used for setting the target.

Dragline Excavator Loads Scows Anchored in Channel It Dug

BY A. I. SILANDER
Civil Engineer, Chicago, Ill.

AN UNUSUAL employment of a dragline excavator is being successfully demonstrated at North Evanston, Ill., as is indicated by the accompanying drawings. The National Brick Co. is under contract with the Sanitary District of Chicago to remove the clay spoil banks along the north channel. The National Brick Co. bought from the contractors, Shnable & Quinn, the excavator that dug this channel.

Fig. 1 shows a cross-section of this channel and one spoil bank, with the position of the 100-ft. boom excavator and the 30 x 100-foot deck scow.

The excavator travels parallel with the channel and heads into the spoil bank. The current in the channel is used in spotting the scow. In dumping, it is found by the operators of the apparatus, this bucket loads the scow without any jar or impact.

Fig. 2 shows a section parallel with the channel and shows also the digging slope with reference to the excavator. The bucket digs down hill and above the base of the excavator as successfully as it dug up hill and below the base of the excavator. After a cut has been completed, and just before moving up, the operator places a loaded bucket in the position shown, then, by dragging it in the direction of the arrow, he pushes away from himself the ridge or roll that accumulates in front of the excavator. By repeating this operation five or six times he cleans and trims up a 30-ft. pathway necessary for laying the next section of runway plank. The ridges outside of this pathway are picked up back of the excavator in passing them.

The Sanitary District is represented by G. M. Wisner, chief engineer, and by William Sullivan, resident engineer. The National Brick Co. is represented by C. J. Weber, general superintendent.

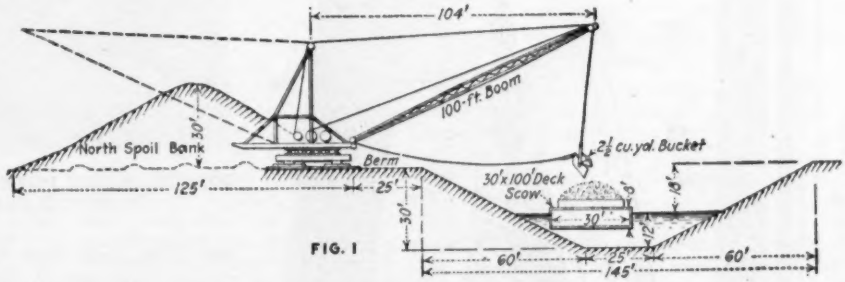


FIG. 1

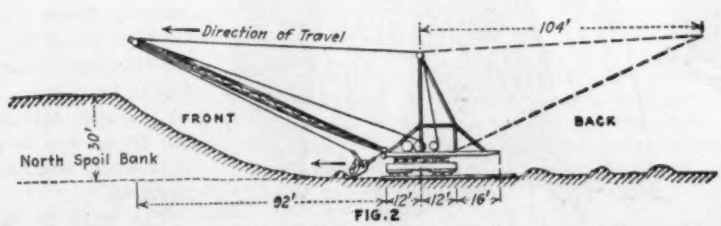


FIG. 2

WIDE RANGE OF EFFECTIVENESS OF DRAGLINE EXCAVATOR SHOWN ON SANITARY CANAL JOB

Convenient Support for Trolley Wire in Tunnels

IN DRIVING the tunnels for the Kerckhoff power plant, the San Joaquin Light and Power Co. of Fresno, Cal., is using electric locomotives operating at 250 volts d. c. If the trolley wire is left in place while the shots are fired, wire and supports are always damaged more or less, so that it has been found desirable to take it down, for each shot, for about 200 ft. back from the heading.

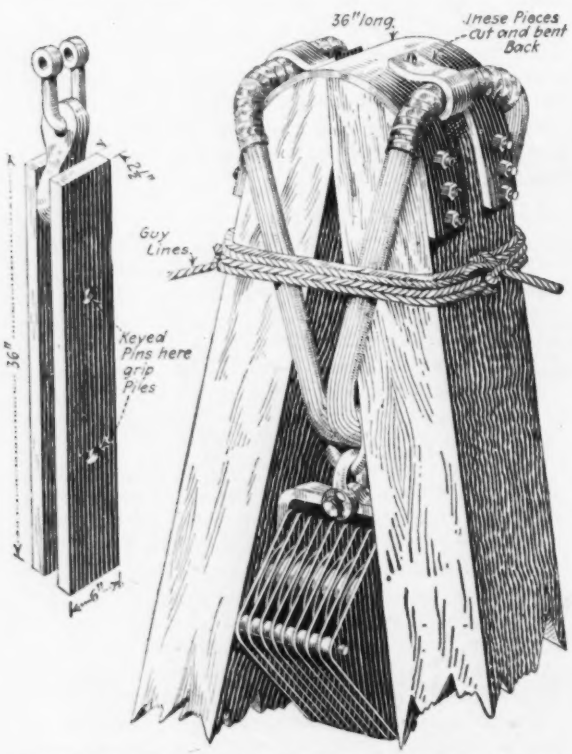
A plan for supporting the trolley wire which has been found very convenient in work of this sort is to drill holes at suitable intervals in the wall of the tunnel near the roof and to slip into these short pieces of 1½-in. pipe. These fit nicely the standard drill size used on the job. The insulator for the trolley wire is carried on a sleeve or slip ring which can be slipped over the end of the pipe and fastened at the desired point by means of a setscrew.

The advantage of this plan is in the ease and speed with which the trolley line can be taken down. At the first few supports near the heading the pipes as well as the slip rings are removed, in preparing for a shot. Farther back the pipe is left in place, the slip rings being loosened and slipped off so that the wire can be rolled up out of the way. The insulator carried on a sleeve, as used on this job, is a standard article, comparatively inexpensive. The pipe is required only in short pieces, such as can usually be cut up from scrap.

A-Frame With 15-Part Line Used For Pulling Steel Sheet Piles

STEEL sheet piles of the Lackawanna type are being pulled from about an average 40-ft. penetration with a specially devised A-frame rig, on the Queenston-Chippawa power canal of the Ontario Hydro-electric Power Commission. One of the bridges here is to carry an interurban electric railway across the canal, but it was built inside a sheeted excavation before the canal was dug. Now that the bridge is finished, the piles are being pulled before the canal has been dug up to the bridge walls.

The rig comprises a heavy A-frame held by guy lines in slightly inclined position over the piles to be pulled, and carrying from the specially designed headframe the two-block 16-part line, at the bottom block of which is attached the pile-pulling grip. The frame is made up by 12x14-in. sticks heavily braced at the bottom and about 10 ft. from the bottom. The headpiece is a 6x1-in. steel plate bent over the curved top, as shown in the sketch herewith, and with interior loops made by cutting the plate as shown in the sketch and bending



DETAILS OF A-FRAME PILE PULLER IN NIAGARA FALLS POWER CANAL

over and riveting down on the top. In these loops are hung wrapped cables which carry the top blocks. Just below the top band the guy lines are wound three or four times around the frame.

The superintendent in charge of the job states that the rig would be more effective if the frame were more thoroughly braced, both with crossbraces and with a heavy wedge block in the crotch, and also that there should be hardwood blocks tacked onto the outside of the frame sticks underneath the guy-line binding.

In the first efforts to pull, an ordinary clevis was used with a pin through a hole cut by a gas flame in the

PULLING SHEET PILES ON THE QUEENSTON-CHIPPAWA POWER CANAL NEAR NIAGARA FALLS

top of the sheet pile. This soon pulled out the pile web, so the grip shown in the accompanying sketch was devised. This consists of two 3-ft. plates 6 in. wide, hanging from the lower block, with two 2¼-in. holes through which the pile is gripped by keyed pins passing also through holes cut by a gas flame in the top of the pile to be pulled. This jaw gives a long, frictional grip on the pile; this has proved very effective. In pulling, the frame has to be braced against timbers as shown. It is easily slid along these timbers from pile to pile as required.

The work is in charge of J. B. Goodwin, who is works engineer, with A. C. D. Blanchard, the chief field engineer.

NEWS OF THE WEEK

New York, January 1, 1920

President Proclaims Return of Railroads March 1

Says Serious Complications Would Be Faced if Properties Went Back on First of Year

By a proclamation issued Dec. 24 the President announced that the railroads and express companies would be returned to private operation Mar. 1, 1920. The President's proclamation was accompanied by a statement issued from the White House that, under existing conditions, it was thought better to postpone the return of properties from the first of the year, in order to avoid legal and financial complications.

The President's proclamation follows:

Whereas, in the exercise of authority committed to me by law, I have heretofore, through the Secretary of War, taken possession of and have, through the Director General of Railroads, exercised control over certain railroads, systems of transportation and property appurtenant thereto or connected therewith, including systems of coastwise and inland transportation, engaged in general transportation and owned or controlled by said railroads or systems of transportation, including also terminals, terminal companies and terminal associations, sleeping and parlor cars, private cars and private car lines, elevators, warehouses, telegraph and telephone lines, and all other equipment and appurtenances commonly used upon or operated as a part of such railroads and systems of transportation; and

Whereas, I now deem it needful and desirable that all railroads, systems of transportation and property now under such Federal control be relinquished therefrom:

Now, therefore, under authority of Section 14 of the Federal Control act approved Mar. 21, 1918, and of all other powers and provisions of law thereto me enabling, I, Woodrow Wilson, President of the United States, do hereby relinquish from Federal control, effective the first day of March, 1920, at 12:01 o'clock a.m., all railroads, systems of transportation, and property, of whatever kind, taken or held under such Federal control and not heretofore relinquished and restore the same to the possession and control of their respective owners.

Walker D. Hines, director general of railroads, or his successor in office, is hereby authorized and directed, through such agents and agencies as he may determine in any manner not inconsistent with the provisions of said act of Mar. 21, 1918, to adjust, settle and close all matters, including the making of agreements for compensation, and all questions and disputes of whatsoever nature arising out of or incident to Federal control, until otherwise provided by proclamation of the President or by act of Congress; and generally to do and perform, as fully in all respects as the President is authorized to do, all and singular the acts and things necessary or proper, in order to carry into effect this proclamation and the relinquishment of said railroads, systems of transportation and property.

For the purposes of accounting and for all other purposes this proclamation shall become effective on the first day of March, 1920, at 12:01 a.m.

At the same time Director General Hines issued a message to railroad officers and employees under Federal control, urging redoubled efforts to produce "the best and most economical railroad service possible during the remaining period of Federal control."

(*Concluded on page* 59)

Short Assignment for Chief of Engineers

(*Washington Correspondence*)

While the Secretary of War declines to make any prediction concerning when he will make his recommendation for the appointment of the Chief of Engineers, U. S. A., it is understood that he does not intend to make a recommendation which would place an officer at the head of the corps for a much longer period than the average tenancy. In the case of Col. Henry Jervey, for instance, 10 years would elapse before he becomes of retirement age. Col. W. C. Langfitt, if appointed, would hold office 4½ years, while Col. F. V. Abbot, if he should be the successful candidate for the post, would serve about two years.

A. A. E. Gets 5000 Applications in Two Weeks' Drive

More than 5000 applications for membership were received as a result of the Dec. 1-13 drive of the American Association of Engineers. The results are not yet tabulated, as the returns are not yet all in, but it is believed at the association's headquarters that the membership increase will be considerably in excess of that figure. The highest percentage of increase over existing chapter membership was that of Buffalo, which up to Dec. 20 was in excess of 300 per cent.

Safety Codes Referred to Engineering Standards Committee

As a result of a conference of organizations interested in uniform safety codes, held at Washington on Dec. 8 and 9, 1919, upon invitation of the Bureau of Standards, the American Engineering Standards Committee will be asked to assume direction of the drafting of safety codes.

The conference supplemented one held on Jan. 15, 1919, when a discussion took place that led to proposals for transforming the standards committee as then constituted into an association. Several months later the association proposal was laid before the founder societies of the committee in the form of a revised constitution, but the opposition to this led to its failure. In the meantime a vote of safety organizations was instituted by the Bureau of Standards, acting for the safety conference, to determine whether the safety-code work were best handled by an independent organization or by the standards committee. The vote went about three to one in favor of the latter alternative.

To Hold Public Works Meeting in Washington

Association Convention January 13-14 To Discuss Campaign Work for New Year

The National Public Works Department Association (formerly the Engineers, Architects and Constructors' Conference on National Public Works) will hold its convention in Washington, D. C., Jan. 13-14, 1920, to discuss the status of the campaign to date and make plans for the new year. A statement of purposes will be made. It is intended to initiate an intensive program.

On the first day of the meeting, after the report of the executive and finance committees, a communication from Gov. Frank O. Lowden of Illinois on "What a Department of Public Works Has Done for Illinois" will be presented. In the afternoon session, reports concerning campaign procedure will be made, and discussion will be open. The Jones-Reavis bill will be discussed by sections, with suggestions for amendment. Representative Reavis will address the meeting on the practical results to be achieved by a United States Department of Public Works, and Gen. R. C. Marshall, chief of the Construction Division, on "Practical Economies Secured by Standardization of Construction Activities."

On the second day of the meeting, "state teams" will confer with members of Congress previous to presenting their reports. Finances will be discussed, and the report of the committees on new organization, nominations, and resolutions will be presented.

Contractors To Hold Annual Session in Chicago

The annual meeting of the Associated General Contractors of America and affiliated organizations will be held in Chicago, Jan. 21-23, 1920. One of the features of the meeting will be a two-day national conference on construction problems, to be held in connection with the business sessions of the association and open to all general contractors, whether members of the A. G. C. or not. The first day of the conference will be devoted to a consideration of industrial relations, and means of greater production, and on the second day the conference will divide into four large groups, representing (1) building contractors; (2) highway contractors; (3) railroad contractors, and (4) public-works contractors, to discuss special problems of interest to these groups.

The business sessions of the annual meeting will be devoted to a discus-

sion of the work of the association during the past year, as presented in the reports of the standing committees; to the election of officers; and to mapping out a program for the coming year. The annual banquet will be held Jan. 22.

At a meeting of the executive board of the association recently in New York, the report of the nominating committee was received. The following were proposed: For president, Frederick L. Cranford, president of Frederick L. Cranford, Inc., New York City; first vice-president, T. T. Flagler, president of the Flagler Co., Atlanta, Ga.; second vice-president, J. W. Cowper, president of the John W. Cowper Co., Buffalo; third vice-president, W. O. Winston, president of the Winston Bros. Co., Minneapolis; treasurer, C. F. Mullen, secretary and treasurer of the Masters & Mullen Construction Co., Cleveland. For members of the executive board (the terms of four of whom expire in January, 1923), R. T. Collins, Jr., Cumberland, Md.; Walter Cahill, Great Lakes Dredge & Dock Co., Chicago, Ill.; A. P. Bent, Bent Bros., Los Angeles, Cal., and George Watson, the Watson Co., Dallas, Tex.

Illinois Section, Am. Soc. C. E., Discusses Development Report

In a discussion, Dec. 19, 1919, of the development committee report of the American Society of Civil Engineers, at the annual meeting of the Illinois Association of Members of the Society, John W. Alvord, head of the analysis committee of the board of directors, outlined an alternative plan for the nontechnical activities. He would broaden and make more representative Engineering Council by having its membership made up mainly of the regular officers elected by the constituent societies and also of delegates from regional associations of societies. A biennial assembly of the estimated 127 members would handle the larger questions and appoint an executive staff or committee as the working body.

Closer coöperation of the association with the Western Society of Engineers will be effected, and combined technical meetings held, if provisions of a report submitted by A. J. Hammond are voted upon favorably in a forthcoming letter ballot. Informal vote was favorable to the idea. Former activities have been confined to nontechnical affairs.

The officers elected for the coming year are as follows: Albert F. Reichmann, chairman; A. J. Hammond, vice-chairman; W. D. Gerber, 913 Chamber of Commerce, Chicago, secretary-treasurer.

Simplon Traffic Diverted To Avoid Avalanche Danger

Exceptional avalanche conditions in Switzerland during the last two weeks of December led to fatalities and the temporary abandonment of railway traffic through the Simplon tunnel, because of threat of slides along both approaches.

Spanish Engineers Urge Big Public-Works Program

Four Thousand Attend National Congress—Public-Works Minister Recommends Expenditure of $601,800,000

(From "Engineering News-Record" Correspondent in Madrid)

The National Congress of Engineers completed Nov. 25 in Madrid the most important conference of technical, industrial and economic leaders that has ever been assembled in the history of Spain. The gathering of more than 4000 engineers and industrial authorities afforded a means of summing up the experience gained in the extensive expansion of Spanish industries brought about during the world war, and gave expression to authoritative conclusions concerning the economic development of Spain in the immediate future. The liberation of the country from dependency on foreign markets for the necessities of economic life was one of the dominating ideas of the congress. The necessity of economic independence from a military point of view was strongly emphasized. The representatives of the army and navy coöperated with civilian technical authorities in developing the plans whereby the industries of the country could most readily lend themselves to national defense. The most important action recommended as an economic-military expedient was the intensive development of mineral resources. Reforestation and agricultural development were cited as other works needed to place the country on a formidable military basis.

The conclusions and recommendations approved by the congress involved:

Governmental financial and legislative aid in the solution of the railroad problem.

A standard gage for all the railroads of Spain.

Creation of a permanent commission to study the standardization of materials, units, and conventional signs used in the mechanical industries and construction.

Establishment of a national testing bureau for machinery, materials of construction, and industrial products.

Increased transportation facilities to the mining districts.

A complete mineral survey of Spain.

A complete survey of the hydro-electric possibilities of the peninsula.

Construction of a network of power transmission lines for the distribution of hydro-electric energy over the entire country.

Increased expenditures on the maintenance of highways.

Construction of more roads into the forest regions for the removal of forest products.

Regulation of the construction of habitations for all classes of society.

Formation of commissions of employers and employees to harmonize industrial relations.

Industrial profit-sharing plan to apply to laborers and administrative forces.

Formation of a Sanitary Engineering Section in the next Congress of Engineers.

Postponement of legislation concerning public works until the Government shall have had sufficient time to make use of the studies made by the Congress of Engineers.

BIG APPROPRIATION RECOMMENDED

That the deliberations of the congress will be of immediate practical value to the nation was demonstrated in the closing session, which was presided over by the Minister of Public Works of the National Government. He announced that, in accordance with the conclusions of the Congress of Engineers, he is recommending to the Parliament the expenditure of $601,800,000 (3,009,000,000 pesetas) during the next ten years for the economic-industrial development of the country. It is recommended that the greater part of this amount be apportioned as follows:

$254,000,000 for the extension of the railroad system;

$193,000,000 for highways;

$48,600,000 for ports and navigation signals;

$14,000,000 for agricultural development and education;

$19,000,000 for reforestation;

$10,000,000 for a mineral survey of the country, laboratories of mineral analysis, and subsidies to mining industries.

The minister recommended that these funds be raised in such manner that future generations may bear a part of the expenditure. He will include in the bill of proposed legislation a revision of the present laws concerning hydro-electric concessions providing that the ownership of these power enterprises revert to the state after a specified interval, and that the Government share in the profits realized.

The Congress of Engineers was held under the auspices of the Institute of Civil Engineers of Madrid. Its success was largely due to Sr. Frederico La Viña, former president of the Institute, Sr. Francisco Teran, present presiding officer, and to Sr. Juan A. Perez Urruti, secretary-general of the congress. The convention enjoyed a large representation from the industries of the country and from various economic societies. The king took a very active interest in the proceedings. He visited the sessions and entertained the members of the congress in the royal palace. An industrial exhibition was held in conjunction with the congress, Nov. 16-25. It is undecided yet as to the date on which the next gathering of the congress will be effected, but it is generally estimated as five years hence.

The congress was called at a very opportune time, a time when Spain has not only the will but the financial means for extensive public undertakings. Notwithstanding the labor unrest, which is evident in nearly all countries, the conclusions of this congress of engineers seem to have expressed the national consciousness.

President Proclaims Return of Railroads March 1

(*Concluded from page* 57)

remaining period of Federal control of the railroads."

In his message cabled to Congress last spring and read before both houses May 20, the President said: "The railroads will be handed over to their owners at the end of the calendar year." There had been some belief that the intention would actually be carried out, in spite of the fact that Congress had not passed a final bill. The President's action in naming March 1, 1920, as the date of return to private operation has met with general approval of corporate and Federal railway officers and leaders of Congress, including the House and Senate conferees who have before them the task of reconciling the differences of the Cummins and Esch bills.

Railroad Bills Go to Conference

With the passage of the Cummins bill in the Senate Dec. 20, the House and Senate Conference Committees began Dec. 23 the task of formulating a final measure, faced with the necessity of the enactment of a bill before the return of the railroads March 1 as proclaimed by the President. The Esch bill, passed by the House, differs from the Senate measure so vitally that the task is considered very difficult.

For the Senate the conferees are Messrs. Cummins, Poindexter, Kellogg, Pomerene and Robinson, and for the House they are George Esch, Edward L. Hamilton, Samuel E. Winslow, Thetus W. Sims and Alben W. Barcley.

In the meantime, labor interests are opposing the anti-strike features of the Cummins bill, and the railway machinists have threatened to walk out if these measures are adopted.

It is expected that it may be necessary for Congress to take actual votes on some of the principal points at issue before the conferees can render a final report. Under the rules of conference, provisions of either bill may be thrown out or altered but new material may not be introduced, although the rules are sometimes violated.

Plan To Pour Concrete on Hetch Hetchy Dam Next June

In a recent address before the San Francisco Association of Members of the American Society of Civil Engineers, M. M. O'Shaughnessy said of the Hetch Hetchy dam: "The foundation has been unwatered by means of a log crib dam 40 ft. high, 300 ft. upstream from the main dam. This turns the water of the river into the diversion tunnel, which is 23 x 25 ft. in section and 900 ft. long. A dam 25 ft. high just above the tunnel outlet prevents the water from backing up into the unwatered site. A steel caisson 120 ft. long in three sections has been arranged to be sunk immediately above and adjacent to the foundation of the main dam on the upstream side, so that the bottom can be entirely unwatered. It is hoped to have this work done by next June, when the foundation concrete will be poured."

The Hetch Hetchy dam contract, as was noted in *Engineering News-Record* of Aug. 7, 1919, p. 292, was awarded to the Utah Construction Co., July 31, under terms requiring its completion within three years.

Would Draw More Water From Niagara

Proposals for a new treaty between this country and Canada to provide for the withdrawal for power purposes of an additional 60,000 cu.ft. per second from the Niagara River above the Falls have been made to the State Department of the United States by Representative Clarence MacGregor, of New York. Under the present treaty the diversion of water for power purposes is limited to 36,000 cu.ft. per second by Canada and 20,000 cu.ft. by the United States. Under the treaty as proposed by Mr. MacGregor each country will be given 30,000 cu.ft. more than it has at present. The agitation for a new treaty will doubtless be seconded in Canada by the Hydro-electric Power Commission of Ontario, which, as noted in *Engineering News-Record* of Dec. 11-18, 1919, is now building a new project which will divert 10,000 sec.-ft. from above the Falls. On account of the greater efficiency of the use of the head and flow through this project, the commission will want to utilize it to its full capacity, but in so doing it will have to shut down several of the existing plants, on account of the restrictions of the Canadian use to the 36,000 cu.ft. per second which is now practically all being utilized in existing plants.

Chimney Construction Companies Indicted

In New York City on Dec. 17 a Federal Grand Jury indicted five chimney construction companies and more than a dozen of their officials on the charge of having organized and operated a trust for the construction of radial brick chimneys in violation of the Sherman anti-trust law. The indictment accuses the dependents with having sought to restrict the business of those allied with the defendant corporations, to fix prices, and to prevent competing concerns from using the same materials and methods in chimney building. It is charged that the Chimney Builders' Association was incorporated in 1914, and that the members agreed to send to the secretary of the association written information of every inquiry received from prospective customers, and to state each quotation or bid submitted. The companies indicted are the Alphons Custodis Chimney Construction Co., the M. W. Kellogg Co., H. G. K. Heinicke, Inc., Bergen & Lindeman, Inc., and the Heine Chimney Company.

French Reconstruction Not for United States Engineers and Contractors

(*From "Engineering News-Record's" Correspondent in Madrid.*)

Very little of the reconstruction of war-devastated regions of France is being done by American engineers and contractors. A recent investigation in France by *Engineering News-Record's* representative shows that one American corporation, having a permanent branch office in Paris, is working on contracts in Alsace for the rebuilding of three small cotton mills, the aggregate of the work running under $50,000. Another United States firm of contractors is occupied on similar small jobs, the bulk of the material for which is being purchased in France.

It seems unlikely that there will be many bulk contracts given for the reconstruction of whole towns or of large areas. The present construction is being done not directly for the French Government but for individual property owners in piecemeal lots. According to the French representatives of two American contractors, there is plenty of work for American concerns which are willing to finance their own work and wait for payment until the German indemnity is paid to the French Government and in turn handed over to the individuals who let the contracts. It may mean a long wait for the money.

It is the opinion of some American engineers now in France that engineers trained in the school of American practice are unsuited to European methods of construction. They have many humorous stories to tell concerning their collisions with the French idea of the way things should be done. Frequently, in dealing with the individual property owner, consideration must be taken not only of the Frenchman's own opinion of the way in which his house should be built, but of the opinions of his father and grandfather before him. However, there is no attempt by these Americans to disparage the work that the French engineer turns out.

The French wish to use their own engineers as extensively as possible. At the present time there is almost no demand for Yankee technical talent in France, and the probability is that there will be no such demand in the next few years. Due to a lack of capital and, to a certain extent, to the labor situation, the reconstruction has proceeded very slowly.

Montana Highway Engineers Meet

The Montana Highway Improvement Association held a meeting in Butte, Dec. 6, for the purpose of consolidating various district organizations into one state body. The organization decided to employ a salaried manager, who will devote his entire time to the management of the affairs of the association. Headquarters of the 11 districts will be established at Missoula, Great Falls, Helena, Butte, Havre, Roundup, Boze-

man, Billings, Miles City, Glendive and Glasgow. Nelson Story of Bozeman was elected president of the consolidated organization and J. A. Harader, Bozeman, secretary.

The next meeting will be held in Billings, Jan. 10, 1920, when the State Highway Commission will meet with the association.

Turner Company Gives Insurance Policies to Employees

At the recent annual dinner of the Turner Construction Co., of New York, held in the ballroom of the Hotel Commodore and attended by 600 of the 800 straight-time employees, Henry C. Turner, president of the company, announced that the board of directors had decided to give all employees paid by the week or month, who had been one year with the company, life-insurance policies with premiums paid by the company.

James E. Kavanaugh, vice-president of the Metropolitan Life Insurance Co., explained the group insurance plan under which the policies were to be issued: To each employee of one year's service, $500, and $100 for each additional year up to a total of $2000. Foremen who have been with the company five years will receive $1000 as the initial amount of insurance. Others will receive amounts according to length of service.

Commerce Bureau Creates New Western European Division

The formation of a Western European Division to meet the growing and insistent demands of American business for facts concerning what is now the key situation in world trade was announced Dec. 5 by Philip B. Kennedy, director of the Bureau of Foreign and Domestic Commerce. For the present the new division will devote itself to England, France, Belgium, and possibly Holland.

The large volume of industrial, financial and commercial inquiries relating to western Europe have heretofore been handled by experts connected with various units in the bureau, but the mass of information now coming in from the many special investigations conducted during the summer and autumn, and the outstanding importance of the situation in western Europe as a factor in future commercial developments, have made it necessary to expand the facilities for handling the work and to center them.

The Western European Division will be in charge of F. W. Powell, who has just returned from England after completing a study of reconstruction in English industry, a report on which will shortly be published. Mr. Powell was connected with the War Trade Board during the war, and previous to that time was engaged in economic research. The division will be organized and conducted along the lines of the Latin-American, Far Eastern, and Russian divisions of the bureau.

Progress in Adjusting Railway Engineers' Salaries

Information concerning recent developments in the adjustment of compensation for railroad professional engineers has been gathered by the American Association of Engineers, which affords the following description of conditions in five regions:

Southwestern Region — Adjustments were made by the regional director, effective Nov. 1. While it is too early to determine just what increases are made, information from the St. Louis & San Francisco and the San Antonio & Aransas Pass indicate an average increase of $25.

Pocahontas Region—The regional director early in December stated that adjustments have been made on the Norfolk & Western and that one is being considered for the Chesapeake & Ohio and for the Virginian.

Allegheny Region — It is indicated that adjustments, effective Sept. 1, covered the Pennsylvania Lines, West, fairly well. A few departments of the Baltimore & Ohio were also included, but no other railroad.

Southern Region — A committee of engineers met at Atlanta late in October and drafted a tentative schedule, following the submission of new data to the regional director by the A. A. E. Sept. 25. The tentative schedule has been submitted to each Federal manager, with the request for recommendation in accordance therewith.

Eastern Region—Data from 1410 new questionnaires were presented to the regional director Nov. 26. He stated that he would take the matter under consideration. The data indicated that adjustments effective July 1 covered less than half of the railroads and less than 35% of the positions, and that present salaries on many roads, particularly the Delaware & Hudson, Erie, and New England roads were very low.

The association reports that the Federal managers were stumbling blocks where no adjustments were made. Therefore, each railroad section has been asked to prepare and transmit to them through official channels a report giving detailed recommendations for the adoption of the A. A. E. schedule on their respective roads.

Conference on Concrete House Construction

In the third week in February, 1920, there will be held at the Auditorium Hotel, Chicago, a national conference on concrete house construction which will be accompanied by meetings of a large number of associated interests. Co-operating in the movement for the conference are the American Concrete Institute, the Associated General Contractors of America, the Concrete Products Association, the Portland Cement Association, the Illinois Society of Architects and Illinois Chapter of the American Institute of Architects.

During the same week the conventions of the American Concrete Institute, the Concrete Products Association, the Concrete Block Machinery Association and the American Concrete Pipe Association will also be held. The conference itself will last from Feb. 17 to 19, 1920, inclusive. The exact dates of the other meetings have not been set. Information regarding them can be obtained from the National Conference on Concrete House Construction, 111 W. Washington St., Chicago, Ill.

To Make Surveys in Sierras

Snow surveys covering the entire length of the Sierra Nevada range are to be made for the purpose of determining the water-supply available from the snow fields and of perfecting a system of stream forecasting and control in the interests of irrigation, flood control and river navigation. This work will be done by co-operative action of the States of Nevada and Cailfornia, the former represented by Prof. J. E. Church, Jr., of the University of Nevada, and the latter by Maj. Paul M. Norboe, assistant state engineer of California. Snow surveys of this kind, with Professor Church's work in Nevada, were described in *Engineering News-Record* of Oct. 23, 1919, p. 766.

Contractor May Forfeit Deposit Check

Rising prices may lead the Walsh Construction Co. of Davenport, Iowa, to forfeit a $10,000 guarantee check on a contract which it has been awarded. The bid concerns the first part of the construction of the Great Western Gateway Bridge over the Mohawk River, between Schenectady and Scotia, New York, being built under the direction of the State Engineer of New York over the Mohawk River and the New York State Barge Canal at Schenectady.

It is a very long and expensive structure, and the work was divided for contract into four parts, the first of which included the construction of the approaches and abutments. Bids were opened for this part on Sept. 12. The Walsh company's bid of $198,880 was accepted by the state. The County and City of Schenectady deposited their share of the cost soon after the bids were opened, but there was considerable delay in the issuance of the Scotia bonds, and the Attorney General of the state ruled that the contract could not be let until all the parties had deposited their shares with the state. This was not completed until Dec. 3. Meanwhile, the price of materials had gone up to such an extent that the Walsh company refused to accept the contract. It is stated that figures show that the cost has increased $17,000 since the bid was made and that it would be cheaper for them to sacrifice the $10,000 certified check than to continue the work on the bid made. Certain business men in Schenectady have offered the Walsh company $10,000 bonus to accept the contract, but this has been refused. Local papers now report the probable offer of a larger bonus.

Pennsylvania To Report Daily on Winter Condition of Roads

The Pennsylvania State Highway Department has announced that it has completed plans whereby all of the main connected hard-surface highways will be kept open for winter traffic, particularly those sections where motor trucks can be used for the transportation of farm products to the centers of population. In order to keep the roads open the department has purchased 10 snow-plow truck attachments in addition to the 16 already on hand. There are also 225 road machines, which are the property of the department, and which will be transferred to the main lines of travel. The district organizations will handle snow removal as they do the department's general maintenance operation.

The State Highway Department on Wednesday, Dec. 10, 1919, began making daily reports on road conditions to meteorologists of the weather bureaus in Philadelphia and Pittsburgh. These bureaus will in turn inform motor clubs, manufacturers and the public in general of the condition of the main connected hard-surface highways over which east-west winter traffic passes. This surface includes the Lincoln Highway between Philadelphia and Pittsburgh, the National Pike within the boundaries of Pennsylvania, the highway between Chambersburg and Harrisburg; the William Penn Highway between Harrisburg and Philadelphia, and the William Penn Highway between Reading and Easton. Each of these thoroughfares has been divided into sections. Superintendents in the various counties will mail each day to the weather bureaus and to the State Highway Department cards giving the condition of the roadways by sections. If any marked changes occur during the night, telegraphic reports will be made the following morning.

Examine Culvert Being Tested Under Deep Fill

As a result of the pioneer work being done by the Iowa State Experiment Station on the action of culverts under earth fills, a joint committee of engineers and manufacturers visited Ames Dec. 4, to study a culvert which is being tested under a deep fill and to study the data already collected for a report on the investigation. The Iowa station is the only organization in the country which has done any work along the lines of actually determining the effect of earth fills and live loads on highway and railroad culverts.

Of the members of this committee on reinforced-concrete culvert-pipe specifications the following were present at the Ames meeting:

G. H. Tinker, Nickel Plate Railroad Co., Cleveland; A. F. Robinson, Santa Fé Railroad Co., Chicago; J. L. Zeidler, Zeidler Pipe Co., St. Joseph, Mo.; C. F. Bunte, Concrete Products Co. of America, Pittsburgh, Penn.; J. E. Moody, Massey Concrete Products Corporation, Chicago; L. D. Hadwin, Chicago, Milwaukee & St. Paul Railroad Co., Chicago; C. F. Wilson, C. H. Wilson and E. L. Arthur, Wilson Concrete Co., Red Oak, Iowa; V. R. Sladek, American Steel and Wire Co., Chicago; M. W. Loving, Portland Cement Association, Chicago.

Extension of 112,500 Hp. Is Dedicated at Niagara

Additions to Station No. 3 Opened by Throwing in First of Three 32,500 Kva.-Unit Installations

In the presence of about 500 prominent guests from Buffalo and Niagara Falls, the switch which formally placed in operation the first of three 32,500-kva. generators in the new addition to the Niagara Falls Power Co.'s No. 3 station, just below the international bridge on the American side, was thrown at 2:30 p.m., Dec. 20, 1919, by J. F. Schoellkopf, chairman of the board of directors of the company. The new extension adds 112,500 hp. to the company's capacity, raising it to a total of 450,000 hp. Station No. 3 is thereby increased from an installed capacity of 130,000 hp. to 242,500 horsepower.

The new unit consists of an Allis-Chalmers 25-cycle, three-phase, 12,000-volt generator rated at 32,500 kva., driven at 150 r.p.m. by a single runner, inward discharge Allis-Chalmers water turbine operating under an effective head of 215 ft. The shaft of the water wheel, directly connected to the generator, measures 27 in. in diameter. The entire unit, from the tailrace to the top of the Kingsbury bearing in the generator housing, stands 67 ft. high. The waterwheel is connected to a penstock 15½ ft. in diameter and 350 ft. long. This penstock opens into a forebay 78 ft. wide by 160 ft. long and 28 ft. deep, fed by a canal with its intake about one-half mile above the American Falls.

Illinois Highway Officials and Contractors Discuss Plans

Materials are available for any amount of paved road whose construction is contemplated in Illinois in 1920, and car service will be ample for handling materials until about August. By getting all materials needed for the season's work into stock pile by Aug. 1, 1920, there ought not to be great delay due to materials shortage. This action will require provision for storing about 25 per cent of the season's supply. In general, these were the conclusions announced at a conference in Chicago, Ill., on Dec. 26, 1919, of officials of the Illinois Division of Highways and representatives of some fifty highway contractors.

Contractors generally will prepare to accumulate stocks during the early months of the year. Other subjects discussed included the length of contracts, time limits, wages and prices, but no definite conclusions were reached.

Chicago Hospital Bill Is Favored by House Committee

Purchase of the 320-acre site for the Speedway Hospital in Chicago is authorized in a bill reported favorably to the House of Representatives by the Committee on Public Buildings and Grounds. The uncompleted hospital building is to be finished and five auxiliary buildings are to be constructed, in accordance with the terms of the bill, but the committee declined to allow the $2,500,000 provision for additional buildings.

The House committee suggested that the Secretary of the Treasury should make a regular estimate to cover that sum, after it has been shown conclusively that additional hospital facilities will be needed by the Government.

It was recommended by the committee that the part of the plant to be immediately completed provide for 995 beds, and in addition give the Public Health Service 120,000 sq.ft. of floor space in a fire-resisting building.

Civil Service Examinations

New Jersey. Deputy chief engineer, Department of Streets and Public Improvements, $6,000 per year, Jan. 28. File applications with State Civil Service Commission at Trenton.

New York State. Assistant sanitary engineer, State Department of Health, $2,000 per year (with possible increase to $2,400), Jan. 24. Apply to State Civil Service Commission at Albany before Jan. 20. Application forms for this examination will not be sent out after Jan. 12.

New York State. Engineering assistant, Office of State Engineer and Highway Department, $1080 to $1560 per year, Jan. 24.

New York State. Engineering draftsman, $1500 to $1800 per year, Jan. 24.

New York State. Junior assistant engineer, grade 1, Office of State Engineer and Highway Department, $1620 to $1860 per year, Jan. 24.

New York State. Junior assistant engineer, grade 2, Office of State Engineer and Highway Department, $1980 to $2280 per year, Jan. 25.

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Architectural and structural steel draftsman, Lighthouse Service, Key West, Fla., $1560 per year, Jan. 6. File application before Jan. 6.

Fire-prevention engineer, office of Director of Purchase and Storage, War Department, duty throughout United States, $2500 to $4000 per year, Jan. 13. Application should be filed before that date.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

BRIDGE BUILDERS' & STRUCTURAL SOCIETY, 50 Church St., New York City; Jan. 16, New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS, 29 W. 39th St., New York City; Jan. 21-22, New York City.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA; 111 W. Washington St., Chicago; Jan. 21-23, Chicago.

ENGINEERING INSTITUTE OF CANADA; General Secretary, Fraser S. Keith, 176 Mansfield St., Montreal; Jan. 27-29, Montreal.

AMERICAN ROAD BUILDERS' ASSOCIATION, 150 Nassau St., New York City; Feb. 9-13, Louisville, Ky.

AMERICAN WOOD-PRESERVERS' ASSOCIATION; Secretary-Treasurer, F. J. Angier, Mt. Royal Station, Baltimore; Feb. 10-12, Chicago.

AMERICAN CONCRETE PIPE ASSOCIATION; 210 South La Salle St., Chicago; Feb. 20-21, Chicago.

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 1426 Manhattan Bldg., Chicago; March 16-18, Chicago.

The American Association of Engineers' second annual conference of professional engineers in railroad service will be held Mar. 15, 1920, in Chicago. The date named is the day previous to the opening of the convention of the American Railway Engineering Association.

The American Concrete Institute, through its board of direction, has appointed Harvey Whipple as secretary. The business office of the institute will be removed from Boston to Detroit; the new quarters will be at 314 New Telegraph Bldg. The board of direction announces that it has important plans for an energetic post-war renewal of activities looking to early standardization in certain design and construction practices.

A Newark, N. J., Chapter of the American Association of Engineers was recently formed, with the following officers: President, Frederic A. Reimer; vice-presidents, Robert A. Meeker and David Boswell; treasurer, John L. Vogel, and secretary, D. W. Krellurtz, West New York, N. J.

The Utica, N. Y., Engineering Society may be the name chosen for an organization of local engineers, the formation of which will be discussed at a meeting Jan. 7 at the Hotel Utica. All local technical engineers have been invited to the meeting. All interested are requested to communicate with Byron E. White, engineer, Utica Gas & Electric Company.

The Baltimore Chapter of the American Association of Engineers increased its membership about 182% during the two weeks of the recent membership campaign, and it was expected that membership in the chapter would reach 500 before the first of the year.

The Engineers and Architects' Association, Los Angeles Chapter of the American Association of Engineers, held a series of meetings in the week ending Dec. 29. They were, respectively, in charge of Carl A. Heinze, Public Service Department; J. F. Lambert, Pacific Electric Ry.; Forrest Casey, General Petroleum Co.; Frank J. Severy, Union Oil Co., and David E. Godfrey, of the State Highway Commission.

The Albany, N. Y., Society of Civil Engineers elected the following officers at the annual meeting Dec. 23: President, Frank H. Macy; vice-presidents, Emory E. Brandow, J. P. Graham and Thomas L. Watkins; secretary-treasurer, John W. Henry; librarian, John W. Carpenter.

The Engineers' Club of the Youngstown, Ohio, District held a regular monthly meeting Dec. 30, at which F. W. Funk, president of the club, presented a paper on "Improved Electric Transit in Youngstown and Interurban Vicinity."

PERSONAL NOTES

LIEUT. COL. D. H. SAWYER has become associated with James Stewart & Co., and will have charge as manager of the work of that company in Detroit and vicinity. Colonel Sawyer was constructing quartermaster in charge of the construction of Camp Grant, and constructing quartermaster of the nitrate plant at Cincinnati and the artillery cantonment at Fayetteville, N. C. Previous to the war he maintained, with his brothers, consulting offices for general engineering work in Spokane and Seattle.

M. C. BYERS, vice-president and general manager, Western Maryland Ry., and previously assistant to the president, is to become the operating head of the road when it is returned to private control, according to recent announcement. Mr. Byers was successively chief engineer of operation of the St. Louis & San Francisco R.R. and assistant to the president of the Great Northern.

CLARENCE H. FAY has been appointed commissioner of public works, Borough of Manhattan, New York City.

E. H. BALDWIN, previously assistant construction engineer, Guggenheim Bros., with supervision of construction work in South America, has been appointed chief construction engineer, Sinclair Refining Co., with headquarters in Chicago. He served 10 years with the Metropolitan Water and Sewerage Board of Massachusetts as assistant engineer and division engineer, followed by 12 years with the United States Reclamation Service as construction and supervising engineer and acting chief engineer of construction. He left the Reclamation Service in 1917 to go to South America for Guggenheim Brothers.

EDWARD B. LEWIS, formerly structural engineer, TOLTZ, KING & DAY, INC., St. Paul, has become associated with Clyde W. Smith, architect, in the general practice of architecture and engineering, with offices in the Andrus Bldg., Minneapolis.

PAUL D. PRATT, M. F. CURRAN, and L. C. BEATTIE have formed the STATE ENGINEERING & CONSTRUCTION Co., engineers and contractors, with headquarters at Helena, Mont.

WILLIAM W. PEARSE, since 1914 city architect and superintendent of buildings for Toronto, Ont., has resigned to become business manager of the Toronto Board of Education.

J. J. COLLINS, W. D. HAMMOND and LINTON HART, formerly of the Raymond Concrete Pile Co. and the Dock Contractor Co., have formed the Rollin Construction Corporation, to engage in general construction, with offices at 90 West St., New York City, and 80 Boylston St., Boston.

R. M. MORTON, formerly engineer of the Sacramento County, California, Highway Commission, has resigned to become chief engineer of the San Diego County Highway Commission, taking office Jan. 1, 1920.

CHARLES J. KALTENBACH has resigned as bridge engineer, West Virginia State Road Commission, to enter industrial work in Pittsburgh.

E. W. MCCOY and J. E. HAMMOND have opened offices in the Brunson Bldg., Columbus, Ohio, to engage in private practice.

C. A. ROTHROCK, former county road engineer, Morgan County, West Virginia, has joined the staff of the Portland Cement Association, with state headquarters at Parkersburg. Mr. Rothrock previously served as maintenance engineer, Los Angeles, Cal., County Highway Association.

OBITUARY

FRANCIS H. KIMBALL, architect of many of the large buildings in New York, died in that city Dec. 25, at the age of 74. In 1867 he entered the office of Gridley J. F. Bryant and Louis P. Rogers, architects, Boston, and afterward took charge of their Hartford office. From that time he was engaged continuously in architectural and structural work. He went to New York in 1879, and later designed several theater buildings, among other work. In 1893 he joined forces with C. K. Thompson to erect the Manhattan Life Bldg. in New York. Among the buildings which he designed

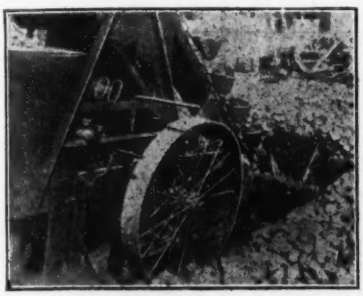
are the Garrick, the Casino and Fifth Avenue Theaters, the United States Realty, Adams Express, City Investing, Empire, Trinity and Manhattan Life Buildings, all in New York City.

JAMES MALONE, who had served for many years as an engineer in the Department of Water-Supply, Gas and Electricity of New York City, died Dec. 23, 1919, in Brooklyn. He retired five years ago.

GEORGE A. LITTLE, superintendent of streets, Ottawa, Ont., died in that city Dec. 17, 1919, at the age of 61.

Self-Feeding Loader Handles Heavy Material

A self-feeding and self-propelling wagon loader, at the plant of the United States Cast-Iron Pipe & Foundry Co., Burlington, N. J., is reported to be doing the heaviest work a loader of this general type has ever performed. The material loaded is brick and débris from a cupola which the



SELF-FEEDING LOADER DIGS PATH THROUGH HEAVY MATERIAL

company has demolished. The accompanying illustration shows the size of the material handled, with the paddles of the loader digging a path and clearing the material away from the wheels so that the machine may be propelled forward by its own power.

The loader is equipped with a swivel spout, instead of a chute, that is designed to swing to 180 deg., so that material can be discharged on either side of the machine as well as in front.

The loader was manufactured by the George Haiss Manufacturing Co., Inc., New York City.

BUSINESS NOTES

THE NEW YORK CONTINENTAL JEWELL FILTRATION CO. of Nutley, N. J., announces the appointment of Arthur M. Crane, formerly general sales manager, as general manager of the company, succeeding the late Robert E. Milligan. D. C. Williamson continues as chief engineer and E. K. Sorenson as secretary and assistant treasurer.

THE WALDO BROS. & BOND CO., Boston, has been formed through the consolidation of Waldo Bros., Inc., building materials, and the Harold L. Bond Co., construction equipment, both of Boston. The Waldo firm was established in 1869, and the Bond Co. in 1900. The officers and directors of the company are: President, Harold L. Bond; first vice-president, C. Sidney Waldo; vice-president, Llewellyn Howland; secretary, Harold C. Bond; sales manager, Frederic W. Mattheis; treasurer, James G. Lincoln. Other directors are Roger Ernst and Frank M. Bates. The offices and salesroom of the new company are at 181 Congress street.

THE READING IRON CO., has acquired the plant of the E. & G. Brooke Iron Co., Birdsboro, Pa., adding 16 double puddling furnaces to the existing equipment of the Reading company.

THE WESTINGHOUSE AIR BRAKE CO., Wilmerding, Pa., has created an export department, in charge of E. A. Craig. The department will be represented in the New York office by W. G. Kaylor and in South America by R. M. Oates.

THE TACONY STEEL CO., Cleveland, announces that A. E. De Clercq has joined its Cleveland sales force.

THE ECONOMY HOIST & BODY CO., INC., 405 Lexington Ave., New York City, will succeed the Economy Body Sales Co., under the same management, with A. W. Herbst as general manager and C. C. J. Culmer as sales manager.

THE AMERICAN STEAM CONVEYOR CORPORATION, Chicago, announces that the Atlas Machinery & Supply Co. is now handling the sale of the "American" steam ash conveyor in the St. Louis territory. The Atlas company is headed by William H. Patton, with offices at 1416 Syndicate Trust Bldg., St. Louis.

TRADE PUBLICATIONS

The following companies have issued trade publications:

THE MILWAUKEE AIR POWER PUMP CO., 886 Third St., Milwaukee, Wis.; pamphlets, 6 x 9 in., 4 to 30 pages, illustrated; all dealing with water systems for institutions, country clubs and homes, schools, farms and other places not served by city water systems. Small electric-light plants and septic tanks for sewage disposal are also described.

THE CITY IRON WORKS, Portland, Ore.; structural-steel and ornamental-iron work manual with tables of sizes, weights, etc., of metal work of the company's manufacture.

THE ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, Wis.; bulletins Nos. 1411 and 1454, 8 x 10½ in., illustrated, 15 and 45 pages, respectively; bulletin No. 1411 gives the specifications of details of modern rock-crushing plant, and bulletin No. 1454 explains the operative principles of the Allis-Chalmers dust collector.

THE WARNER ELEVATOR MANUFACTURING CO., Cincinnati, Ohio; bulletin, 9 x 12 in., illustrated, 12 pages; descriptive matter on motors, cages, etc.

THE AMERICAN CEMENT MACHINE CO., INC., Keokuk, Iowa; catalog No. 920, 8½ x 11 in., 63 pages, illustrated, describing "'Boss' Labor-Saving Construction Machinery." It contains descriptions of various forms of contractors' concrete machinery and equipment, with illustrations of their use.

The Outlook for Construction in 1920

A Serious Shortage of Materials—Prices the Tangible But Not the Determining Factor in This Year's Work

BY ALDEN W. WELCH
Of the Business News Department, McGraw-Hill Company

The present remarkable condition of the material market is not the work of any one cause. The steel strike, the coal shortage, the high prices and, finally, the unprecedented autumn volume of construction work, are the important factors that have produced a shortage in certain lines of building materials.

Last spring we were deploring the lethargy in the construction field; everything, except high prices and false prophets, urged tremendous activity. The country was years underbuilt. Nearly every state and municipality cried for repair and enlargement of public works, while the housing problem was every bit as acute as it is today. In spite of this, capital, suffering from an excess of caution, held back, waiting for conditions to "stabilize." With exasperating deliberation, work got under way, until now—even in this winter season—the demand for materials in many cases exceeds the supply.

DEMAND

Some idea of the demand may be had by a comparison of the value of contracts being awarded at the present time and in similar periods of 1918 (an unusually dull year) and in 1913 (a normal year). Such a study will show that the present requisition on construction materials is quite unusual, in spite of the reduced purchasing power of the dollar.

The one tangible factor that held back construction and ultimately caused the present jam was the high level of prices. There is no denying that prices were high and are now still higher, but, whereas a year ago capi-

tal was demanding a radical reduction, capital now acknowledges that high prices are here to stay—for a few years, at least. What was called abnormal last January is now accepted as normal. In fact, there is a strong feeling—already substantiated in certain lines—that prices will be still higher next spring.

Prices

What are the facts on prices? The quotations published monthly in *Engineering News-Record* furnish full and trustworthy data for study.

Basic construction materials divide into two classes, as regards price tendencies in 1919. One group, including steel and concreting materials, has remained practically stationary in the mills are on full production. Even so, it is equally conceivable that steel prices will advance about that time.

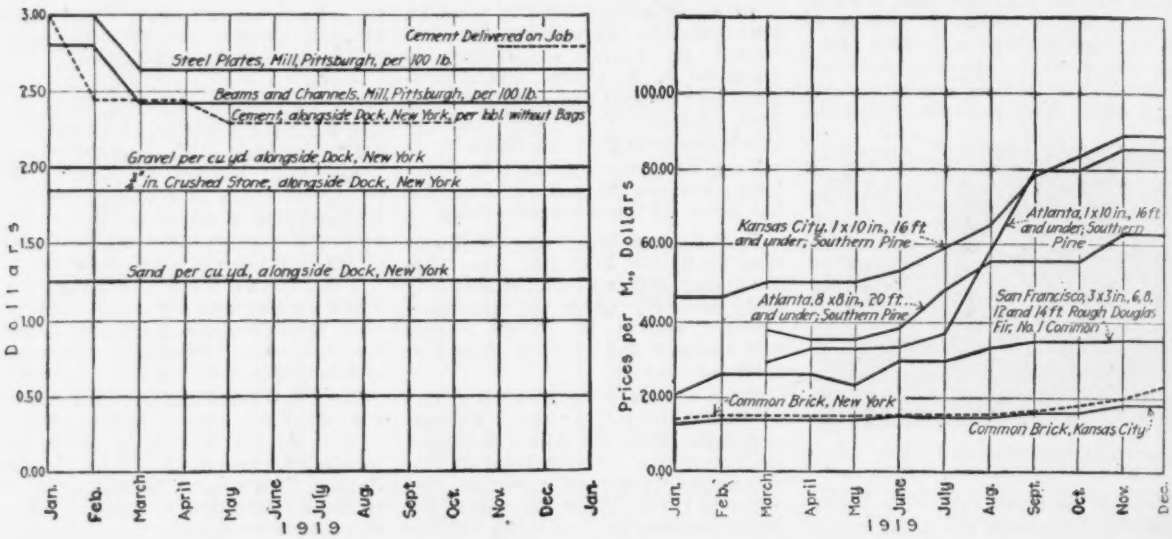
In the case of cement, stocks over the country are relatively light, owing to the small demand during the first half of 1919 and the heavy ordering in the last six months. Prices have fluctuated but little, but a general increase in the spring would not be surprising. Already two companies have advanced their price 25c. per barrel.

Prices of sand and gravel remain practically as they were a year ago, but it is significant that in important instances an advance of 25c. per cubic yard is asked for spring deliveries. New York men in this line state that seven years' work has piled up and that a booming 1920 is anticipated, with

vest in what seemed inflated valu today the situation is reversed.

Far from subsiding, the vitality today will probably be compounded in the spring, which promises to be the liveliest construction period in the history of the country. It would seem inevitable that prices should stiffen.

As a final argument, consider wages. Indicative is the recent agreement entered into between the Building Trades Employers' Association and the Building Trades Council, of New York, which reads: "In order to secure continuity of employment and uninterrupted production . . . . the working week shall consist of 44 hours; the rates of wages from Jan. 1, 1920, to Dec. 31, 1921, shall be as follows: Carpenters, $8 per day; dock builders.


Cement Delivered on Job
Steel Plates, Mill, Pittsburgh, per 100 lb.
Beams and Channels, Mill, Pittsburgh, per 100 lb.
Cement, alongside Dock, New York, per bbl. without Bags
Gravel per cu. yd. alongside Dock, New York
¾ in. Crushed Stone, alongside Dock, New York
Sand per cu. yd., alongside Dock, New York
Dollars
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Jan. Feb. March April May June July Aug. Sept. Oct. Nov. Dec. Jan.
1919
Prices per M. Dollars
100.00
80.00
60.00
40.00
20.00
0.00
Kansas City, 1x10 in., 16 ft. and under; Southern Pine
Atlanta, 1x10 in., 16 ft. and under; Southern Pine
Atlanta, 8 x8 in., 20 ft. and under; Southern Pine
San Francisco, 3x3 in., 6, 8, 12 and 14 ft. Rough Douglas Fir, No. 1 Common
Common Brick, New York
Common Brick, Kansas City
Jan. Feb. March April May June July Aug. Sept. Oct. Nov. Dec.
1919

PRICE TREND DIVIDES CONSTRUCTION MATERIALS INTO TWO GROUPS HAVING WIDELY DIFFERENT CHARACTERISTICS

quoted price; the other group, of which lumber and brick are the features, has advanced rapidly to unheard-of levels. The situation is graphically portrayed by the two charts.

The first set of curves is particularly remarkable for the steadiness with which prices of certain building materials have held during the year. Since last March there has been absolutely no fluctuation in prices of steel plates, structurals, cement, sand, gravel or crushed stone. Of course, during the past few months this steadiness has meant little to construction progress, owing to decreased production occasioned by strikes. Not only have the mills, in many instances, withdrawn quotations, but warehouse stocks have been seriously depleted as well. A shortage of railroad cars has aggravated the situation. It is almost impossible to obtain certain gages of steel sheets, and reinforcing steel is held at a premium. Consequently, it must be distinctly understood that the quoted steel prices have little meaning just at present. This speculative element, however, will endure only until the labor difficulties have been adjusted and plenty of stock to supply the demand, however great the latter may be. With crushed stone the situation is much the same. In New York the official price is $1.85 per cubic yard; but 25c. more could easily be obtained for spring deliveries. Poor transportation facilities have seriously interfered with stone and gravel deliveries on highway work, and have thus thrown a heavy demand over into 1920.

As regards the second group of essential construction materials, a glance at the right-hand set of curves will indicate what has happened. In the case of lumber, heavy demand has made it possible to inflate the market. The effect of these lumber prices is far-reaching. It means a curtailment of the use of lumber and a turning, where possible, to steel and concrete on the part of former lumber users. The brick market is of a local nature, but in certain centers—notably New York and St. Louis—the prices are extremely high.

Conclusion

To sum up, the high prices of a year ago are in no case lower today. Half a year ago capital was reluctant to in-

house shorers and sheet pilers, $7.50; composition roofers and waterproofers, $7.50; granite cutters, $8; hoisting engineers, $9; metallic lathers, roofers, painters, sheet-metal workers and tile layers, $8; plasterers, $8.50. . . . . Provided, should the cost of living materially change . . . . the wage schedule for 1921 shall be reopened and readjusted." It is further agreed that "the unions as a whole or as a single union shall not order any strike . . . . nor shall any member of the Building Trades Employers' Association lock out his employees." Finally, "the unions agree to furnish at all times sufficient men to man the work of the association."

This means that New York contractors and their men are ready to handle the expected spring rush, and it is believed that this is the attitude generally throughout the country. There are many indications that engineering and construction stand on the threshold of a big year. The country is so far underbuilt that prices have become subsidiary to necessity. Construction must go forward even in the event of a slightly rising market.